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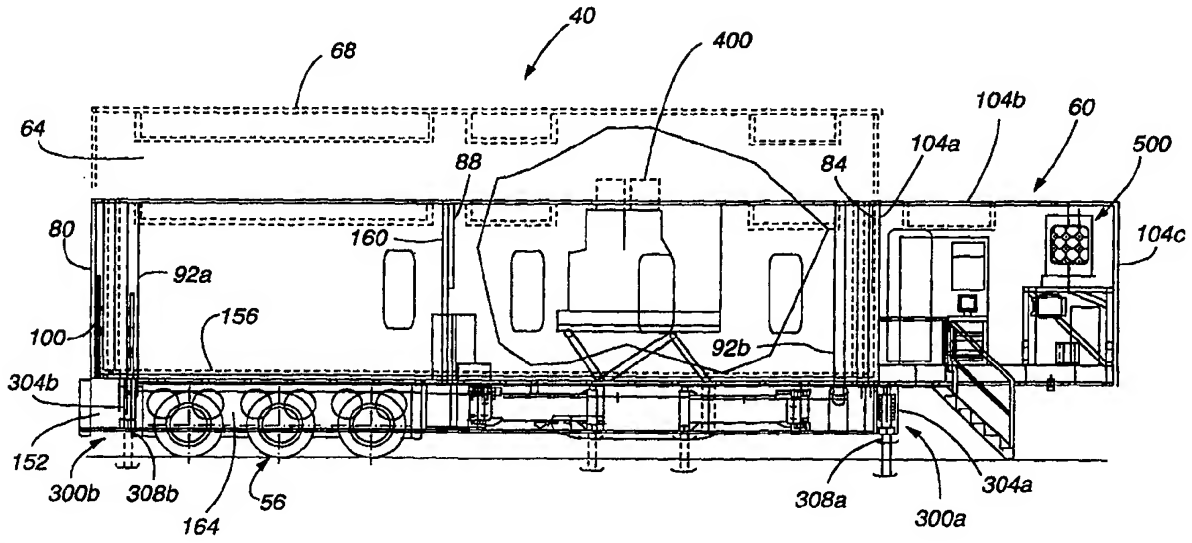

(57) Abstract

The expandable/retractable mobile unit of the present invention includes a number of features that are highly advantageous. The unit includes a roof assembly that can be elevated and a side extension assembly that can be moved outward on either side of the unit to provide for a significantly expanded enclosed volume. The unit can further include outrigger assemblies to laterally support the expanded structure, a self–leveling system to level the unit prior to expansion, and a full or partial motion flight simulator mounted within the unit.

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EXPANDABLE AND RETRACTABLE MOBILE UNIT

FIELD OF THE INVENTION

The present invention relates generally to expandable and retractable structures and specifically to expandable and retractable mobile units, such as trucks and trailers.

BACKGROUND OF THE INVENTION

Expandable and retractable enclosures, especially those provided by trucks and semitrailers, are useful in applications where more enclosed space is required than would be otherwise provided by a bus, coach, a nonexpandable/ nonretractable semitrailer, or a container. Such applications include the use of mobile expandable/retractable enclosures as a classroom or other type of training facility, auditorium, medical clinic, command center, dispensary, mobile office, and exhibition room, and as a recreational and travel vehicle.

Expandable/retractable trailers have a number of design problems. Such a trailer should not have a small expansion volume which is inadequate for many applications. By way of example, many existing expandable/retractable trailers have roofs that fail to elevate and/or sides that fail to expand outwardly. The procedures to expand and/or retract the trailer are labor and time intensive and, therefore, costly. Many expandable/retractable trailers require cumbersome structural members to be erected and/or the execution of preparatory construction work (such as providing a flat surface or foundation). Other trailers require a multiplicity of difficult and complex manual steps (such as folding out and/or rotating wall and floor panels and erecting internal and external support members). When expanded, the trailer should be relatively stable and have a relatively large loading capacity. Finally, the enclosed space of the expanded trailer is obstructed by structural members and fail to provide a clear span interior.

SUMMARY OF THE INVENTION

It is an objective of the present invention is to provide an expandable and retractable trailer, rail car, truck or other mobile unit that expands to provide a relatively large enclosed volume. A related objective is to provide an expanded truck or trailer having a clear span interior and/or a roof and side that expands outwardly.

Another objective is to provide an expandable/retractable trailer, truck or other mobile unit that is simple and not labor intensive to expand and retract. A related objective is to provide an expandable/retractable trailer, truck or other mobile unit that does not require cumbersome structural members to be erected, that does not require the execution of preparatory construction work before expansion, and/or that can be expanded and retracted automatically.

Yet another objective is to provide an expandable/retractable trailer, truck or mobile unit that is relatively stable and has a large loading capacity when expanded.

The present invention realizes these and other objectives by providing a mobile unit, such as a trailer, truck, rail car and the like, that expands into an enclosed structure. One embodiment of the mobile unit includes: (i) a base section providing a floor for the structure; (ii) a roof section located above the base section; (iii) a first connector between the roof section and the base section for moving the roof section in a vertical direction relative to the base section; (iv) a side extension that moves inwardly and outwardly relative to the base section; (v) a side panel depending from one of the roof and base sections and forming an upper surface of the side extension when the side extension is retracted and projected outwardly relative to the base section; and (vi) a second connector between the side panel and the side extension for rotating the side panel relative to the side extension when

the side extension is retracted and projected outwardly relative to the base section.

The roof section can elevate relative to the base section by means of the first connector. The first connector can be a plurality of actuators, with an actuator being positioned at each corner of the roof section. The first connector can also include means for determining the elevation of the roof section relative to the base section to prevent under- or overelevation of the roof section. The determining means can, for example, be a limiter switch.

The mobile unit can include a three-sided side extension that axially moves inwardly and outwardly like a bottomless drawer. The side panel forms the roof of the side extension and a vertically stowed floor panel rotates outwardly and downwardly to form the floor of the side extension. Thus, when the side extension is moved inwardly, the side extension is in a nested relationship relative to the roof and base sections. An extension panel is rotatably mounted on the side extension or side panel for filling the triangular gap that exists between the top of the side extension and the bottom of the side panel.

The first connector and side extension provide not only for a relatively large enclosed volume but also for a clear span interior. Few, if any, structural members are required within the enclosed space for integrity of the structure.

The procedure for expanding and retracting the unit is relatively straightforward and can be fully automated. The automation of the process reduces the need for manual labor and/or a crane for unit expansion and retraction, and greatly simplifies unit expansion and retraction.

The second connector can be connected to the side panel by means of a guide means for guiding the second connector. The guide means can be a channel, track, or the like positioned on the side panel or the side extension. The second connector can be configured such that one member

of the second connector rotates relative to another member of the connector as the second connector travels along the guide means.

The side panel can engage the base section such that, when the roof section is in a first vertical position, the side panel is in a locked position and, when the roof section is in a second vertical position, the side panel has freedom of movement. The first and second vertical positions are different. To realize this result, the side panel can include a projecting member received by a gap in the base section or vice versa.

The mobile unit can be a trailer having an axleless suspension system for the unit's wheels. A storage unit can be positioned between the opposing sets of wheels for additional storage.

To partition the enclosed space after unit expansion, the unit can include a partition hinged about at least one of the roof section, base section and side extension. When the side extension is moved outwardly relative to the base section, the partition forms an interior wall of the enclosed structure.

To provide for additional enclosed space, the mobile unit can include another side extension located on the opposite side of the mobile unit from the above-noted side extension. To store the side extensions in the limited volume of the unit when the unit is retracted, the side extensions can be offset from one another in the unit. Thus, when the side extensions are moved inwardly, the ends of the side extensions are in an overlapping relationship.

To support relatively large loads, the mobile unit can include one or more outriggers. The outrigger supports the side extension during axial movement thereof and has a base for shifting a portion of the weight of the side extension to a surface below the mobile unit. For convenient storage, the outrigger is rotatably connected to the base section such that the outrigger rotates in a plane that is substantially parallel to a plane of the base section. In

a storage position, the outrigger is substantially parallel to a longitudinal axis of the base section and in a deployed mode is oriented transversely to the longitudinal axis. The outrigger can have a guide means for guiding the side extension during axial movement thereof.

The mobile unit can perform self-leveling when deployed on an uneven and/or nonlevel surface. The mobile unit includes determining means for determining the orientation of the base section relative to a horizontal plane and generating a signal indicating the orientation and leveling means for controlling the orientation of the base section relative to the horizontal plane in response to the signal from the determining means. By way of illustration, the determining means can be a mercury microswitch, pendum switch, and other suitable electronic or mechanical sensing devices. The leveling means can be a plurality of actuators positioned at different locations on the base section.

The abilities of the mobile unit to expand into a large clear span interior and support heavy loads when expanded permit the mobile unit to house a full motion flight simulator. The enclosed space has a sufficient volume to provide unobstructed freedom of movement for the full motion flight simulator. The full motion flight simulator can be moved by a plurality hydraulic pistons in a variety of positions over a relatively large range of movement. The mobile full motion flight simulator is advantageous to airline and airfreight companies, especially smaller companies, to meet FAA requirements regarding initial or upgrade crew training. Such training can be performed at lower hourly costs than training in an aircraft and, in some cases, than training in immobile full motion flight simulation facilities.

The present invention further includes a method for expanding and retracting a mobile unit. In one embodiment, the method includes the steps: (i) moving the roof section in a vertical direction; (ii) moving the side extension

outwardly relative to the roof section; and (iii) rotating the side panel in a plane transverse to a longitudinal axis of the mobile unit.

Additional steps can be performed during expansion and retraction. The floor panel can be rotated to form the floor of the side extension. The outrigger can be rotated outwardly to support the side extension. The orientation of the base section can be determined and the signal generated and a portion of the base section elevated in response to the signal.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cut-away view of the expandable/retractable trailer, showing the position of the top panel when fully retracted and expanded, the range of motion of the flight simulator, and the fully stored position of the outrigger assemblies and the leveling actuator subassemblies;

Fig. 2 depicts, in plan view, the various components of the expandable/retractable trailer in the fully expanded and fully retracted positions, including the full range of motion of the flight simulator;

Fig. 3 is a cross-sectional view taken along line B-B of Fig. 2 perpendicular to the longitudinal axis of the trailer, showing the positions of the various components in the fully expanded and fully retracted positions and the range of motion of the flight simulator;

Fig. 4 depicts the view of Fig. 1 above, except that certain components have been omitted to more clearly depict various features of the invention;

Fig. 5 depicts the view of Fig. 2 above, except that certain components have been omitted to more clearly depict various features of the invention;

Fig. 6 depicts the view as Fig. 3 above, except that certain components have been omitted to more clearly depict various features of the invention;

Fig. 7 is an end view of the hydraulic pump and motor along the lines A-A of Fig. 2;

Fig. 8 is a plan view of the frame;

Fig. 9 is a side view of the frame showing drive shafts and miter gear boxes comprising the mechanical drive system which powers the vertical actuating subassemblies;

Figs. 10-12 depict the vertical actuating subassembly in various positions with Fig. 10 omitting the outer cylindrical housing;

Figs. 13A-C depicts the outrigger assembly in side, end, and plan views;

Figs. 14 and 15 depict the side extension partition and the fixed interior wall panel in plan and side views in the expanded and retracted positions;

Fig. 16 depicts the extension of the interior panel in the expanded and retracted positions;

Figs. 17-25 depict the sequence of steps required to fully expand and fully retract the expandable/retractable trailer;

Figs. 26 and 27 depict the steps to automatically expand the trailer (Fig. 26) and retract the trailer (Fig. 27); and

Figs. 28A-C depict the rotating shoe subassembly.

DETAILED DESCRIPTION

Referring to Figs. 17 and 18, an expandable/ retractable trailer in accordance with the present invention is depicted in the retracted (over the road) configuration. The trailer includes a roof assembly 40, a base assembly 44, suspension system 48, storage compartment 52 between the opposing sets of wheels 56, and control room subassembly 60.

Referring to Figs. 24 and 25, the trailer is depicted in an expanded configuration. The roof assembly 40 is elevated above the level of the roof assembly in the retracted configuration. Side panels 64a,b are hinged about a top panel 68 to provide roofs for side extensions

200a,b. Outrigger assemblies 262 on each side of the trailer provide support for the structure. The control room 60 is not expandable as is the remaining portion of the trailer.

The volume of the trailer when fully expanded is considerably larger than the volume of the trailer when fully retracted. The expanded volume can be 200% or more of the retracted volume. This large increase in volume results from the abilities of the roof section to be elevated and the side extensions to be moved outwardly.

The Roof Assembly

Referring to Figs. 1 and 3, the roof assembly 40 includes the top panel 68, a rear panel 80, a front protective panel 84, an interior panel 88, side panels 64a,b, a plurality of vertical actuating subassemblies 92a-d positioned on each side of the trailer, and a vertical actuating drive subassembly 96. When the top panel 68 is elevated by the vertical actuating subassemblies 92a-d, the rear panel 80, front protective panel 84, and interior panel 88 move upwards. The rear panel 80 and front protective panel 84 protect the interior of the enclosed space from the terrestrial environment when opened or deployed. This is accomplished by the rear panel 80 being in an overlapping relationship with a rear protective panel 100 included in the base assembly 44 and the front protective panel 84 contacting the rear wall 104 of the control room 60.

The side panels 64a,b are hinged about the peripheral edges of the top panel 68. When the trailer is fully retracted, the side panels are in a locked position. Each of the side panels includes a projection 108a,b at the lower end of each side panel 64a,b which is received in a matching slot (not shown) contained in the base assembly 44. When the roof assembly 40 is fully elevated, the projection 108 is removed from the slot and each of the

side panels has freedom of movement (i.e., freedom of rotation) about its respective hinge 112a,b.

Referring to Figs. 10-12, the plurality of vertical actuating subassemblies are illustrated in a retracted position (Fig. 11) and extended position (Fig. 12). The vertical actuating subassembly 92 is positioned adjacent to each of the four corners of the top panel 68 for a total of four subassemblies 92a-d. Each of the vertical actuating subassemblies 92a-d includes a cylindrical extension 116 telescopically connected to an outer cylindrical housing 120, a threaded inner barrel 124 for moving the cylindrical extension 116 inwardly and outwardly via a floating nut 128. The threaded inner barrel 124 rotates clockwise and counterclockwise to raise and lower the cylindrical extension 116. The lower end 132 of the outer cylindrical housing 120 is attached to the base assembly 44 and the upper end 136 of the cylindrical extension 116 to the top panel 68.

The vertical actuating subassemblies 92a-d are actuated in unison by a common hydraulic pump and motor 500 connected to a vertical actuating drive subassembly 140. Referring to Fig. 8, the vertical actuating drive subassembly 140 includes a plurality of drive shafts 144a-f interconnected by a number of miter gear boxes 148a-c. In this manner, the hydraulic pump powers the hydraulic common motor which in turn rotates a central drive shaft (not shown). The rotational motion of the central drive shaft is translated to each of the four vertical actuating subassemblies 92a-d via the various drive shafts 144a-f and miter gear boxes 148a-c. Each of the vertical activating subassemblies 92a-d can include a limiter switch to determine the extent of extension or retraction of the cylindrical extension 116 and to prohibit movement beyond established bounds.

The Base Assembly

Referring to Figs. 1-6 and 8-9, the base assembly 44 includes a trailer frame 152, a floor panel 156, the rear protective panel 100, a fixed interior wall panel 160, the control room subassembly 60, a plurality of wheels 56 supported by an axleless suspension system, and a lower storage compartment 164 located between the sets of wheels on each side of the trailer.

Referring to Figs. 8 and 9, the trailer frame 152 is comprised by a gridwork of steel support members 170a-m. In the area 174 where a full motion flight simulator is to be mounted and the area 178 where the control room equipment is located, the support members 170 have relatively large cross-sectional areas and are more densely distributed to support relatively large loads (i.e., area 174 of the frame has a load-bearing capacity of about 5,000 psi or more and more preferably about 7,000 psi or more). The support members are preferably at least about 6,000 psi, more preferably at least about 6,500 psi, and most preferably at least about 13,000 psi steel. In the area 182 where the classroom is located, fewer support members 170 are employed than in area 174 (e.g., the support members in area 182 are less densely distributed) due to lighter loading of the frame (i.e., area 178 of frame has a load-bearing capacity of 1,000 psi or less and preferably about 500 psi or less). As noted in Fig. 8, area 182 has a region extending between support members 170a and b and to the left of support member 170c that is free of lateral and central support members. The total weight of the frame ranges from about 20,000 to about 25,000 lbs.

The floor panel 156 extends the length and width of the frame 152, with the rear protective panel 100 being located at the rear end of the trailer and the control room subassembly 60 at the front end of the trailer.

The control room subassembly 60 is fully enclosed by a plurality of fixed panels 104a-e and contains computer hardware, various motors, and other equipment. As noted

above, the control room subassembly 60 includes a rear wall 104a to separate the control room interior from the interior of the rear portion of the trailer.

The plurality of wheels 56 and the lower storage compartment 164 are located at the rear of the trailer. The use of the axleless suspension system provides space for the lower storage compartment 164. The lower storage compartment 164 is mounted on tracks to permit the compartment to be moved inwardly and outwardly in the same manner as a drawer.

The Side Extension Assemblies

Referring to Figs. 1-6, the trailer includes a side extension assembly 200a,b located on each side of the trailer. Each of the side extension assemblies 200a,b includes a rollout unit 204a,b, a side extension partition 208a,b, a side extension floor panel 212a,b, a rollout drive subassembly 216, and a rotating shoe subassembly 220.

The rollout unit 204 is a three-sided, bottomless and topless structure that rolls inwardly and outwardly relative to the base and roof assemblies. After the rollout unit 204 is fully retracted, the unit 204 is nested within the base and roof assemblies. As can be seen from Fig. 2, end panels 220a,b of rollout unit 204a are offset relative to adjacent end panels 220c,d of rollout unit 204b to permit the units 204 to be simultaneously housed within the base and roof assemblies. Thus, the adjacent end panels 220a and 220c at one end and 220b and 220d at the other end are in an overlapping relationship. The offset between the rollout units 204a,b provides space efficiency and allows the interior of the trailer when fully retracted to have unobstructed clear span in the interior for installation of items such as a flight simulator. The rollout units 204a,b are approximately the same size and length. The distance between the pairs of adjacent end panels 220a,c and 220b,d is sufficient to receive triangular-shaped extension panels 224a and 224d attached

to the upper end of the side panels 220a and 220d. Each of the end panels 220a-d have the attached triangular-shaped extension panel 224a-d hinged to the upper edge of each end of the end panels 220 to fill the various triangular-shaped gaps 301a-d between the side panels 64a,b and the top of the various end panels 220.

A side extension partition 208a,b corresponds to each of the opposing rollout units 200a,b. The side extension partitions 208 are hinged about the fixed interior wall panel 160 and rotate into the position when the rollout units are fully extended. The side extension partitions 208 rotate in a plane substantially parallel to the floor panel 156. Each of the side extension partitions 208a,b include a triangular-shaped extension panel 228a,b attached to the upper end of the partitions to fill the correspondingly-shaped triangular gaps 301 between the corresponding side panels 64a,b and the top of the partition 208.

A side extension floor panel 212a,b corresponds to each of the opposing rollout units 204a,b. The side extension floor panels are hinged about the peripheral edges of the floor panel 156 and stored in a vertical position when retraction. After the rollout unit 204 is fully extended, the side extension floor panels 212a,b are rotated by hydraulic cylinders into position at the base of the respective rollout units 204a,b. The panels 212a,b are rotated in a plane normal to the longitudinal axis 230 of the trailer.

The rollout drive subassembly 216 moves the rollout units 204a,b inwardly and outwardly relative to the roof and base assemblies 40,44. The rollout drive subassembly 216 includes a plurality of drive shafts 234a-f interconnected by miter gear boxes 238a-c. The central miter gear box 238b is connected to a central drive shaft (not shown) such that the various drive shafts 234a-f can be simultaneously actuated by the common hydraulic pump and hydraulic motor 500. The motor is connected to the central

drive shaft. Each of the drive shafts 234a-b and e-f has a rack and pinion system 242a-d mounted at the end to roll the corresponding rollout unit inwardly and outwardly.

Referring to Figs. 3 and 28, a rotating shoe subassembly 250a,b is located at the center of each rollout unit 204a,b to guide the side panel relative to the rollout unit during expansion and retraction. Each rotating shoe subassembly 250a,b has a stationary member 254a,b and a rotational member 258a,b hinged about the stationary member 254a,b. The stationary member 254a,b is attached to the corresponding rollout unit and the rotational member 258a,b to a guide track 303a,b extending substantially the width of the corresponding side panel 64a,b and located on the underside of the side panel. As the rotational member 258 traverses the guide track 303a,b during movement of the rollout unit 204 relative to the side panel 64, the rotational member 258 rotates relative to the stationary member 254 which is immovably fixed to the rollout unit 204. The rotating shoe subassembly 250 provides the mechanical energy to rotate the side panels 64a,b outward to become the roof for the rollout units 204, secures the side panel 64 to the rollout unit 204 and prevents forces such as strong winds and the like from damaging the hinge of the side panel 64.

Referring to Figs. 28a-c, the stationary member 254 is attached to the outer wall of the rollout unit 204 by means of bolts 400. The bolts 400 are attached to a plate 404, which is in turn attached to the body 408 of the stationary member 254. The rotational member 258 includes an arm 412 attached to a plurality of rollers 416. The rollers 416 project outwards on either side of the arm 412 and movably engage the guide track 303. A cotter pin 420 movably connects the stationary member 254 with the rotational member 258 to permit rotation of the rotational member relative to the stationary member.

The Outrigger Assemblies

Referring to Figs. 2 and 13, the outrigger assemblies 262 are depicted. Each of the outrigger assemblies 262a-d include a support arm 266a-d and attached outer housing 268a-d hinged about a base member 270a-d, and a hydraulically actuated support cylinder 274a-d and attached support pad 276a-d that moves in a direction perpendicular to the support arm 266a-d. As shown in Fig. 2, two outrigger assemblies 262 are located on each side of the trailer. After the roof assembly 40 is retracted, the outrigger assemblies 262 are located behind the projections 108 on the side panels 64.

The support arm 266 is hinged about the base member 270, which is attached to the frame 152, to permit the support arm to be placed in separate storage and deployment positions. In the storage position, the support arm 266 is substantially parallel to the longitudinal axis 230 of the trailer. In the deployment position, the support arm 266 is substantially normal to the longitudinal axis 230. The upper surface 280 of one or both of the support arms 266 on each side of the trailer can include a track 284 extending the length of the support arm 266 to engage a roller mounted on the bottom of the corresponding rollout unit to facilitate movement of the unit. The upper surface 280 of the support arms can also be used to support the side extension floor panels when rotated into a deployed position.

The outrigger assemblies 262 are rotated from a stowed into a deployed position by means of the hydraulic pump noted above connected to a hydraulic motor which is in turn connected to each of the outrigger assemblies 262. The same hydraulic pump also causes the support cylinders in each of the outrigger assemblies 262 to move upwardly or downwardly as desired.

The outrigger assemblies 262 collectively provide lateral stability to the expanded structure and support to the rollout units 204 during transit to and from the fully

deployed position. Typically, the outrigger assemblies 262 collectively support at least about 25% of the total weight of the trailer and more typically at least about 35% of the total weight of the trailer.

The Self-Leveling System

Referring to Figs. 1 and 4, the self-leveling system includes an arrangement configured for determining the orientation of the base assembly relative to the horizontal (not shown) and a plurality of leveling actuator subassemblies 300a-d for selectively elevating portions of the base assembly in response to a signal generated by the arrangement.

The arrangement includes a sensor (not shown) for determining the orientation of the base assembly 44 and a central processor (not shown) for generating the signal in response to information received from the sensor and forwarding the signal to the appropriate leveling actuator subassembly. The sensor can be a number of suitable devices, including a mercury microswitch, pendulum switches, and other electronic or mechanical sensing devices. The software used in the central processor is discussed below.

Referring to Figs. 10-12, the leveling actuator subassemblies 300a-d include an outer leveling housing 304a-d to mount the subassembly to the frame 152 and a leveling extension 308a-d telescopically mounted in the outer leveling housing 304a-d.

The leveling extension is hydraulically activated. As will be appreciated, the leveling extension can be actuated by other techniques, including electronic and manual techniques. A leveling actuator subassembly 300a-d is located at each of the four corners of the frame 152.

The Flight Simulator Assembly

Referring to Figs. 1-6, a full or partial motion flight simulator 400 is mounted to the frame 152 inside of

the trailer. The flight simulator can be any of the simulators known in the art. When fully retracted, the trailer has an free space large enough to contain the flight simulator 400. Preferably, the enclosed volume is at least about 1,024 cubic feet. When fully expanded, the free space is large enough to permit unobstructed movement of the flight simulator 400. To permit unobstructed movement of the flight simulator, the free space is free from structural members for the expanded enclosure. The free space in the expanded mode is preferably at least about 200% of the free space in the retracted mode. The free space in the expanded mode typically is at least about 5,460 cubic feet and more typically ranges from about 5,000 to about 10,000 cubic feet.

The Operation of the Expandable/Retractable Trailer

Referring to Figs. 17 and 26, the operation of the expandable/retractable trailer will now be described. The various steps discussed below can be conducted manually or automatically. Fig. 26 depicts a flow schematic for computer software to automatically control the various steps.

As shown in Fig. 19 when the trailer arrives at a deployment site, the trailer self-levels before the various components are expanded. A sensor located anywhere on the trailer base assembly determines the orientation of the floor panel 156 relative to a horizontal plane and generates a signal which is forwarded to the central processor. The central processor forwards a control signal to a device for controlling the flow of hydraulic fluid to each of the subassemblies 300a-d. The control signal indicates which of the subassemblies 300a-d is to be extended or retracted. This process is continued iteratively until each of the subassemblies 300a-d is at the appropriate degree of extension to provide a substantially horizontal floor panel 156. The floor panel

156 typically is within 6 minutes of one degree of horizontal.

Referring to Fig. 20 when leveling is completed, the central processor actuates a valve to permit each of the vertical actuating subassemblies 92 to extend to the desired level, which causes the roof assembly 40 including the side panels to move upwards. Limiter switches on one or more of the subassemblies 92 provide signals to the central processor to permit the central processor to issue appropriate commands to close the valve when the vertical actuating subassemblies 92 are at the desired level. At this level, the projections 108 on the side panels 64 are removed from the slot and are free to rotate outwardly and expose the outrigger assemblies 262. The vertical actuating drive subassembly 96 causes all of the vertical actuating subassemblies to simultaneously extend to the desired level.

Referring to Fig. 21 after the roof assembly 40 is raised to the desired level, the outrigger assemblies 262 are deployed. To deploy the outrigger assemblies, the central processor actuates a valve to cause the hydraulic pump to rotate the support arms to the fully deployed position (i.e., substantially normal to the longitudinal axis 230 of the trailer). After the support arms 266 are fully deployed, the central processor actuates another valve to cause the support cylinders 274 and attached support pads 276 to project downwards and contact the ground below the trailer. The various support cylinders 274 do not extend too far downwards to avoid disturbing the horizontal orientation of the floor panel.

Referring to Figs. 23-24 after the outrigger assemblies 262 are fully deployed, the central processor causes the rollout units 204a,b to move outward to their respective fully deployed positions. The rollout units 204a,b are moved outward by the rollout drive subassembly 216 using tracks mounted on the upper surfaces 280 of at least one of the aft support arms on each side of the

trailer. As the rollout units 204a,b move outward, the rotating shoe subassembly 250a,b on each rollout unit 204a,b causes the corresponding side panel 64a,b to rotate outwardly in a plane transverse to the longitudinal axis 230 of the trailer to form the roof of each rollout unit 204a,b. The side panels are slanted at full expansion of the trailer to facilitate drainage. The rotational member 258a,b of each rotating shoe subassembly 250a,b traverse the track on the underside of the corresponding side panel 64a,b and rotate relative to the corresponding stationary member 254a,b.

After the rollout units 204a,b are in the fully deployed position, the central processor causes the side extension floor panels 212a,b to rotate in a plane transverse to the longitudinal axis 230 to a horizontal position to form the floor of the corresponding rollout unit. The side extension partitions 208a,b can be rotated outward to partition the space enclosed by each of the rollout units. The various triangular shaped extension panels 224a-d and 228a-b can be rotated into position to fill the various triangular-shaped gaps 301a-d between the bottoms of the side panels and the top of the rollout units. The resulting enclosed space is a fully enclosed and fully climate controlled interior environment.

While various embodiments of the present invention have been described in detail, it is apparent that modifications and adaptations of those embodiments will occur to those skilled in the art. By way of example, the invention can be mounted on the bed of a truck and various components can be omitted depending upon the application. It is to be expressly understood, however, that such modifications and adaptations are within the scope of the present invention, as set forth in the following claims.

What is claimed is:

1. A mobile unit that expands into an enclosed structure, comprising:

a base section providing a floor for the structure;

a roof section located above the base section;

a first connector between the roof section and the base section for axially moving the roof section relative to the base section in a vertical direction;

a side extension that moves inwardly and outwardly relative to the base section, the side extension having a panel forming a side of the enclosed structure;

a side panel depending from one of the roof and base sections and forming an upper surface of the side extension when the side extension is moved inwardly and outwardly relative to the base section; and

a second connector between the side panel and the side extension for rotating the side panel relative to the side extension when the side extension is moved inwardly and outwardly relative to the base section.

2. The mobile unit of Claim 1, wherein the base section comprises a floor panel which rotates in a plane transverse to a longitudinal axis of the base section, such that, when the side extension is moved outwardly relative to the base section, the floor panel rotates outwardly to provide a floor for the volume enclosed by the side extension.

3. The mobile unit of Claim 2, wherein when the side extension moves inwardly relative to the base section, the floor panel rotates inwardly to a vertical position relative to the base section.

4. The mobile unit of Claim 1, wherein the first connector comprises means for determining the elevation of the roof section relative to the base section.

5. The mobile unit of Claim 1, wherein the first connector comprises a plurality of actuators for axially moving the roof section in a vertical direction, with an

actuator being positioned at each corner of the roof section.

6. The mobile unit of Claim 1, wherein, when the side extension is moved inwardly relative to the base section, the side extension is in a nested relationship relative to the roof and base sections.

7. The mobile unit of Claim 1, wherein the mobile unit comprises a second side extension that moves inwardly and outwardly relative to the base section, the side extension having a panel forming a side of the structure, each of the side extension and second side extension having at least two opposing ends, and wherein, when the side extension and the second side extension are both moved inwardly relative to the base section, each of the opposing ends of the side extension overlap at least one of the opposing ends of the second side extension.

8. The mobile unit of Claim 1, wherein the side extension has an end panel positioned at each of two opposing ends of the side extension and the panel is positioned between the end panels.

9. The mobile unit of Claim 8, wherein, when the side extension is moved outwardly relative to the base section, a gap exists between the side panel and the top of the panel and at least one of the side panel and side extension comprise an extension panel rotatably mounted thereto having a size sufficient to be received by the gap.

10. The mobile unit of Claim 1, wherein the side panel depends from a peripheral edge of the roof section.

11. The mobile unit of Claim 10, wherein the side panel is hinged about the roof section.

12. The mobile unit of Claim 1, further comprising a plurality of wheels connected by an axleless suspension system.

13. The mobile unit of Claim 1, further comprising a partition hinged about at least one of the roof section, base section and side extension such that, when the side extension is moved outwardly relative to the base section,

the partition forms an interior wall of the enclosed structure.

14. The mobile unit of Claim 1, wherein the side extension moves inwardly and outwardly from a first side of the base section and further comprising a second side extension that moves inwardly and outwardly from a second side of the base section, the first and second sides being in an opposed relationship to one another.

15. A mobile unit that expands into an enclosed structure, comprising:

a base section providing a floor for the structure;

a roof section located above the base section;

a side extension that axially moves inwardly and outwardly relative to the base section, the side extension having a panel forming a side of the structure;

a first connector between the base section and the side extension for axially moving the side extension inwardly and outwardly relative to the base section;

a side panel pivotably connected to one of the roof and base sections, the side panel forming an upper surface of the side extension when the side extension is moved inwardly and outwardly relative to the base section; and

a second connector between the side panel and the side extension, the second connector being movably engaged with at least one of the side panel and the side extension such that, when the side extension moves inwardly and outwardly relative to the base section, the second connector connects the side extension to the side panel.

16. The mobile unit of Claim 15, wherein at least one of the side panel and side extension comprises a guide means for guiding the second connector such that, when the side extension moves outwardly relative to the base section, the second connector moves along the guide means.

17. The mobile unit of Claim 16, wherein the guide means comprises a channel for receiving a member of the second connector.

18. The mobile unit of Claim 15, wherein a portion of the second connector rotates when the side extension moves inwardly and outwardly relative to the base section.

19. A mobile unit that expands into an enclosed structure, comprising:

a base section providing a floor for the structure;

a roof section located above the base section;

a first connector between the base and roof sections for axially moving the roof section relative to the base section;

a side extension that moves inwardly and outwardly relative to the base section, the side extension having a panel forming a side of the structure; and

a side panel forming an upper surface of the side extension, wherein, when the roof section is in a first vertical position, the side panel is in a locked position and, when the roof section is in a second vertical position, the side panel has freedom of movement, the first vertical position being different from the second vertical position.

20. The mobile unit of Claim 19, wherein the side panel comprises a projecting member and the base section comprises a gap for receiving the projecting member when the roof section is in the first vertical position.

21. A mobile unit that expands into an enclosed structure, comprising:

a base section including a floor panel;

a roof section located above the base section;

a side extension that axially moves inwardly and outwardly relative to the base section and a connector for axially moving the side extension, the side extension having a panel forming a side of the structure; and

an outrigger rotatably connected to the base section, the outrigger (i) supporting the side extension during axial movement thereof, (ii) having a base for shifting a portion of the weight of the side extension to a surface

below the mobile unit, and (iii) rotating in a plane that is substantially parallel to a plane of the base section.

22. The mobile unit of Claim 21, wherein, in a storage position, the outrigger is substantially parallel to a longitudinal axis of the base section and, in a deployed position, the outrigger is oriented transversely to the longitudinal axis.

23. The mobile unit of Claim 21, wherein the mobile unit comprises a plurality of outriggers.

24. The mobile unit of Claim 21, wherein the outrigger supports at least about 25% of the weight of the mobile unit.

25. The mobile unit of Claim 21, wherein the outrigger comprises a guide means for guiding the side extension during axial movement thereof.

26. The mobile unit of Claim 25, wherein the guide means comprises a channel that receives a member of the side extension.

27. A mobile unit that expands into an enclosed structure, comprising:

a base section providing a floor for the structure;

a roof section located above the base section;

a side extension that projects and retracts relative to the base section;

determining means for determining the orientation of the base section relative to a horizontal plane and generating a signal indicating the orientation; and

leveling means for controlling the orientation of the base section relative to the horizontal plane in response to the signal from the determining means.

28. The mobile unit of Claim 27, wherein the determining means comprises at least one of a mercury microswitch and pendulum switch.

29. The mobile unit of Claim 27, wherein the leveling means comprises a plurality of actuators connected to different parts of the base section.

30. A mobile flight simulator, comprising:

a mobile unit including;

a base section providing a floor for the structure;

a roof section located above the base section; and

a side section that projects and retracts relative to the base section to form an enclosed space; and

a full motion flight simulator contained within the enclosed space, the enclosed space having a sufficient volume to provide for freedom of movement of the full motion flight simulator.

31. The mobile unit of Claim 30, wherein the enclosed space has a volume of at least about 5,460 cubic feet.

32. The mobile unit of Claim 30, wherein the enclosed space is substantially free of obstructions to the movement of the full motion flight simulator.

33. A mobile flight simulator, comprising:

a mobile unit including;

a base section providing a floor for the structure;

a roof section located above the base section;

a side section; and

means for moving at least one of the base section, roof section, and side section to expand the space enclosed by the mobile unit, such that, in a retracted mode the mobile unit encloses a first space that is sufficient to contain the full motion flight simulator and in a deployment mode the mobile unit encloses a second space that is sufficient to provide for freedom of movement of the full motion flight simulator; and

a full motion flight simulator contained within the mobile unit.

34. The mobile unit of Claim 33, wherein the second space is at least about 200% of the first space.

35. The mobile unit of Claim 33, wherein the first space has a volume of at least about 1,024 cubic feet.

36. The mobile unit of Claim 33, wherein the second space has a volume of at least about 5,460 cubic feet.

37. The mobile unit of Claim 33, wherein the first space is substantially free of structural members for the mobile unit.

38. The mobile unit of Claim 33, wherein the second space is substantially free of structural members for the mobile unit.

39. A method for expanding a mobile unit into an enclosed structure and for retracting the enclosed structure, comprising:

moving a roof section of the mobile unit in a vertical direction;

moving a side extension of the mobile unit outwardly or inwardly relative to the roof section; and

rotating a side panel of the mobile unit in a plane transverse to a longitudinal axis of the mobile unit to provide an upper surface of the side extension.

40. The method of Claim 39, further comprising:

rotating a floor panel to form a floor for the side extension.

41. The method of Claim 39, further comprising:

installing a wall panel in a gap between the side extension and the side panel.

42. A method for expanding a mobile unit into an enclosed structure and retracting the enclosed structure, comprising:

rotating an outrigger connected to a base section of the mobile unit in a plane that is substantially parallel to a plane of the base section and

axially moving a side extension outwardly or inwardly relative to the base section of the mobile unit.

43. A method for expanding a mobile unit into an enclosed structure and retracting the enclosed structure, comprising:

determining the orientation of a base section of the mobile unit relative to a horizontal plane and generating a signal indicating the orientation; and

elevating a portion of the base section in response to the signal to orient the base section substantially parallel to the horizontal plane.

44. A mobile flight simulator, comprising:

a mobile unit including;

a base section providing a floor for the structure;

a roof section located above the base section; and

a side section that projects and retracts relative to the base section to form an enclosed space; and

a flight simulator contained within the enclosed space, the enclosed space having a sufficient volume to provide for freedom of movement of the flight simulator.

45. The mobile flight simulator of Claim 44, wherein the enclosed space has a volume of at least about 5,460 cubic feet.

46. A mobile flight simulator, comprising:

a mobile unit including;

a base section providing a floor for the structure;

a roof section located above the base section;

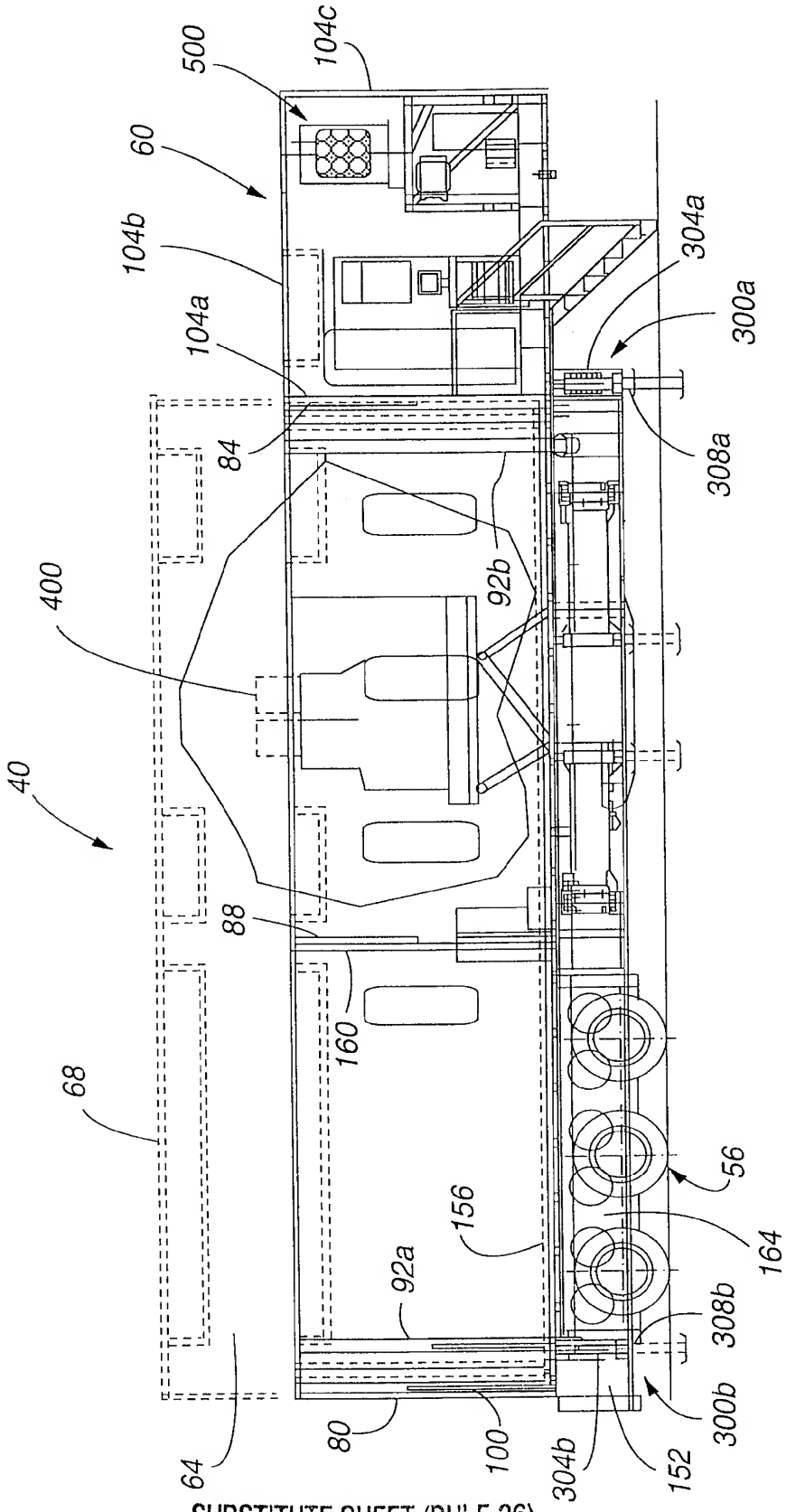
a side section; and

means for moving at least one of the base section, roof section, and side section to expand the space enclosed by the mobile unit, such that, in a retracted mode the mobile unit encloses a first space that is sufficient to contain the full motion flight simulator and in a deployment mode the mobile unit encloses a second space that is sufficient to provide for freedom of movement of the full motion flight simulator; and

a flight simulator contained within the mobile unit.

47. The mobile flight simulator of Claim 46, wherein the second space is at least about 200% of the first space.

48. The mobile flight simulator of Claim 46, wherein the first space has a volume of at least about 1,024 cubic feet.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104b
104a
84
304a
300a
308a
92b
400
40
88
160
68
64
80
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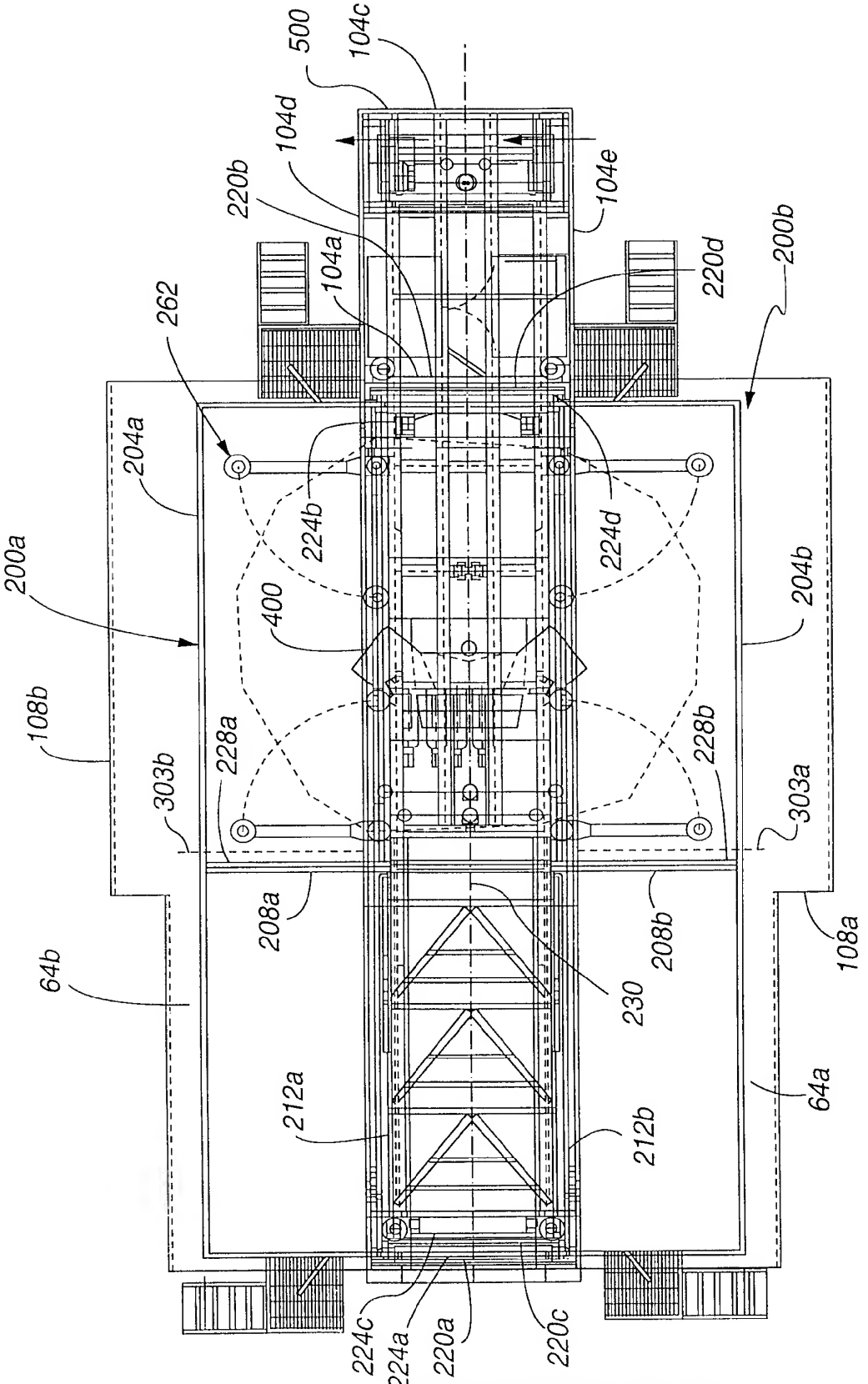
152
300b
308b
164
56
156
92a

Fig. 1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400
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228b
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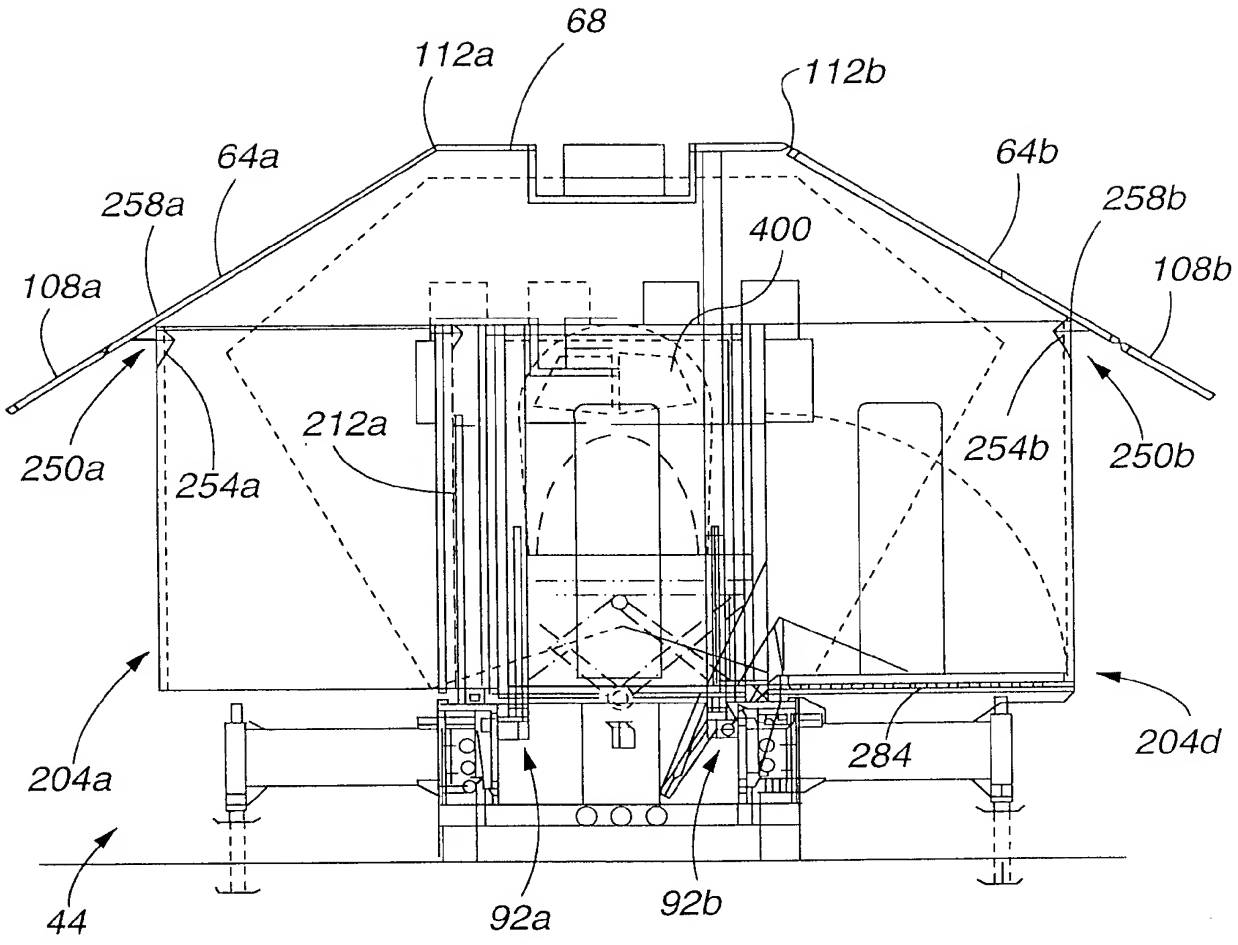
212b
64a
224c
224a
220a
220c

Fig. 2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112a
112b
64a
64b
258a
258b
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108b
250a
254a
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254b
250b
204a
284
204d
44
92a
92b

Fig. 3

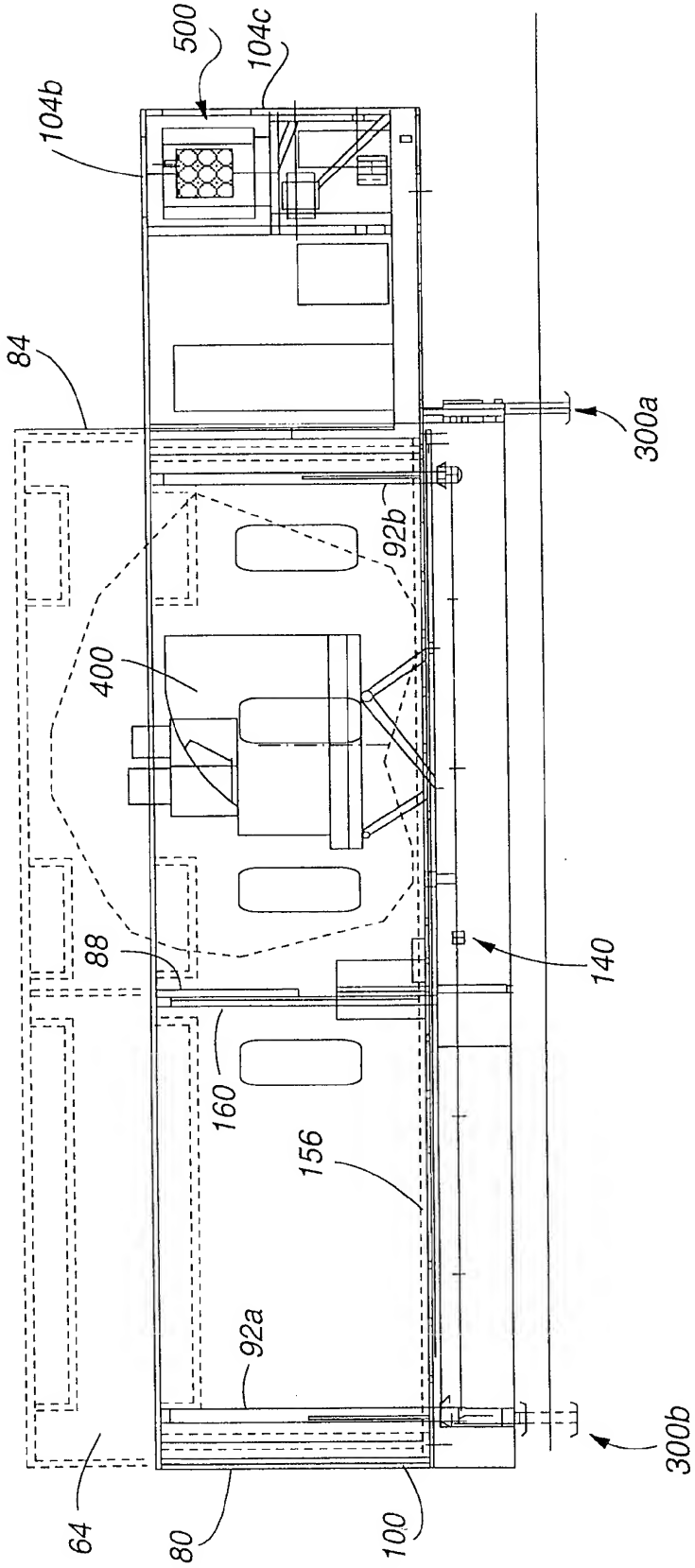
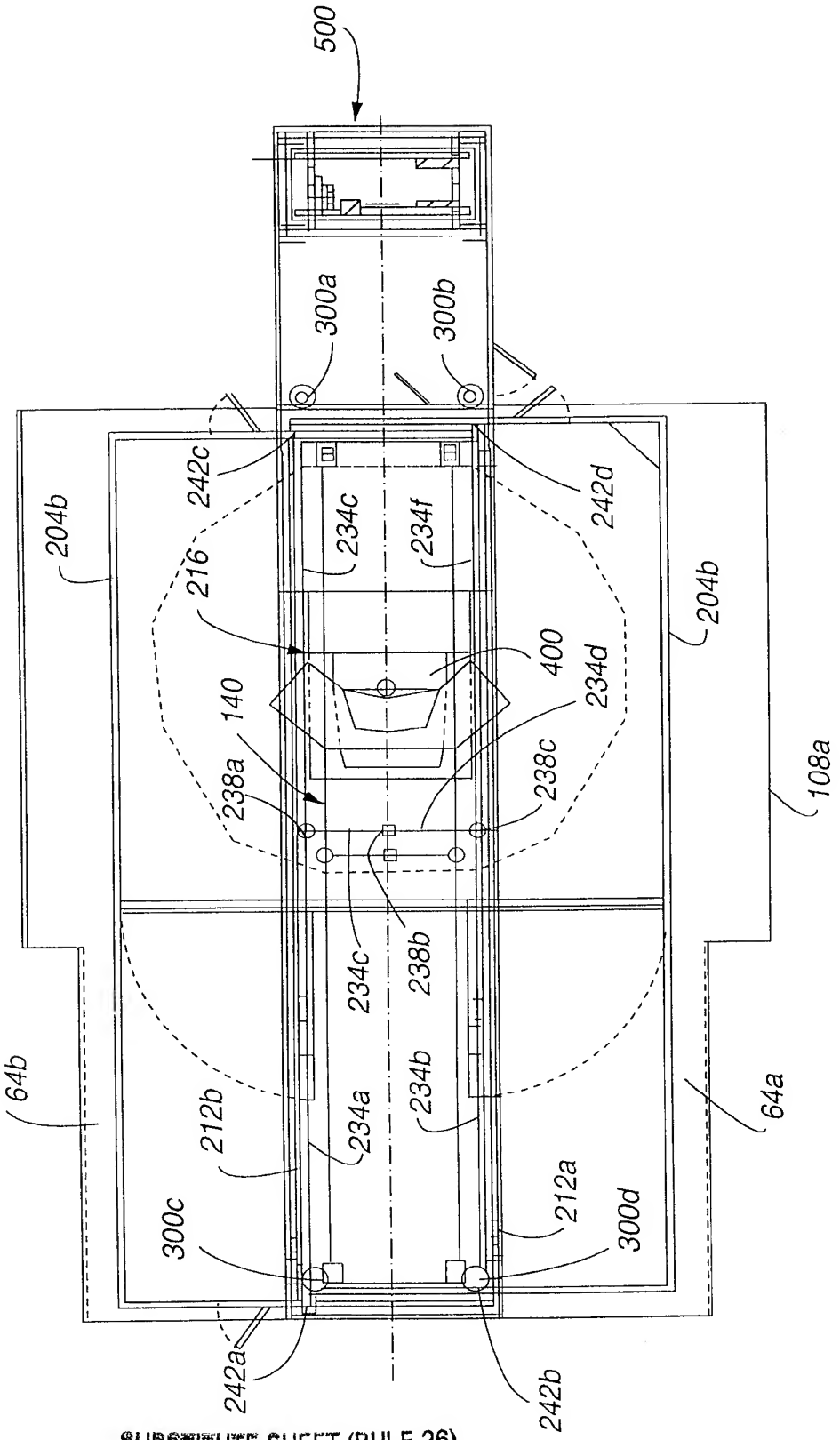


Fig. 4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242d
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204b
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234f
216
400
234d
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238c
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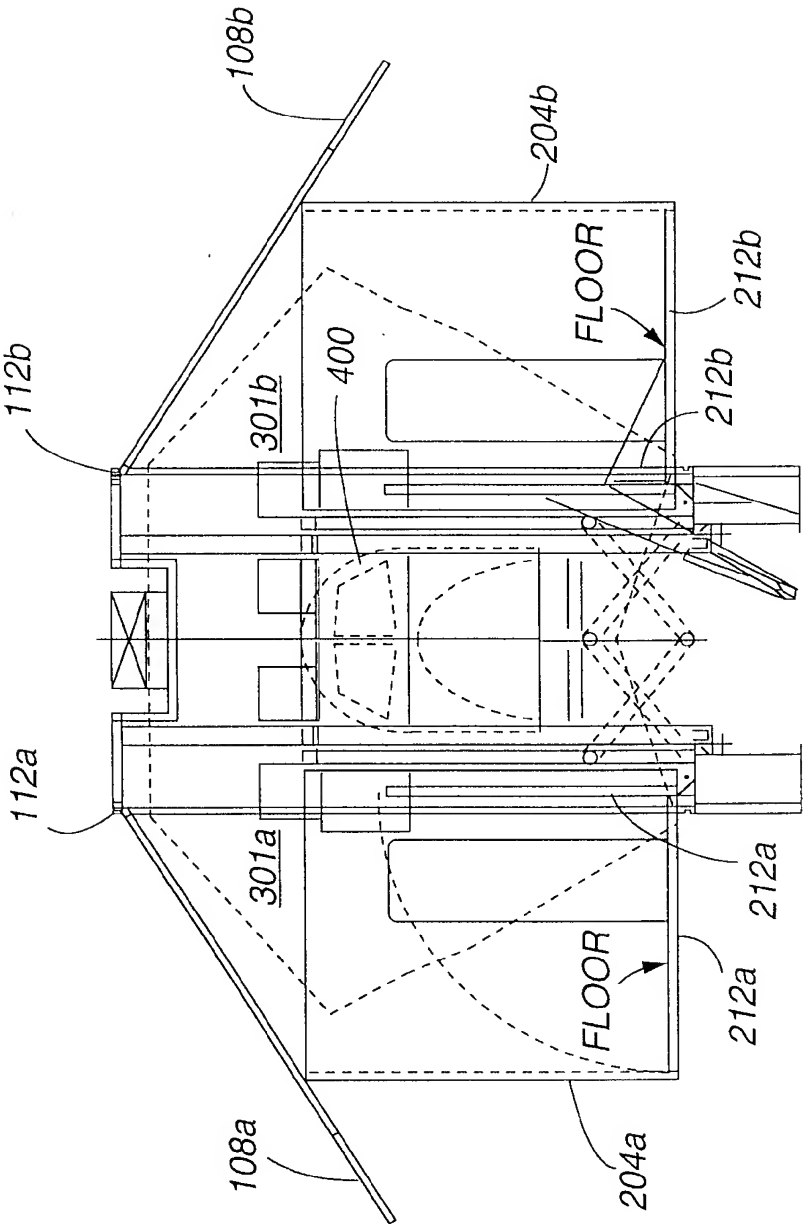
238b
64b
64a
212b
234a
234b
212a
300c
300d
242a
242b

Fig. 5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204b
FLOOR
212b
112b
301b
400
212b
112a
301a
212a
FLOOR
212a
108a
204a

Fig. 6

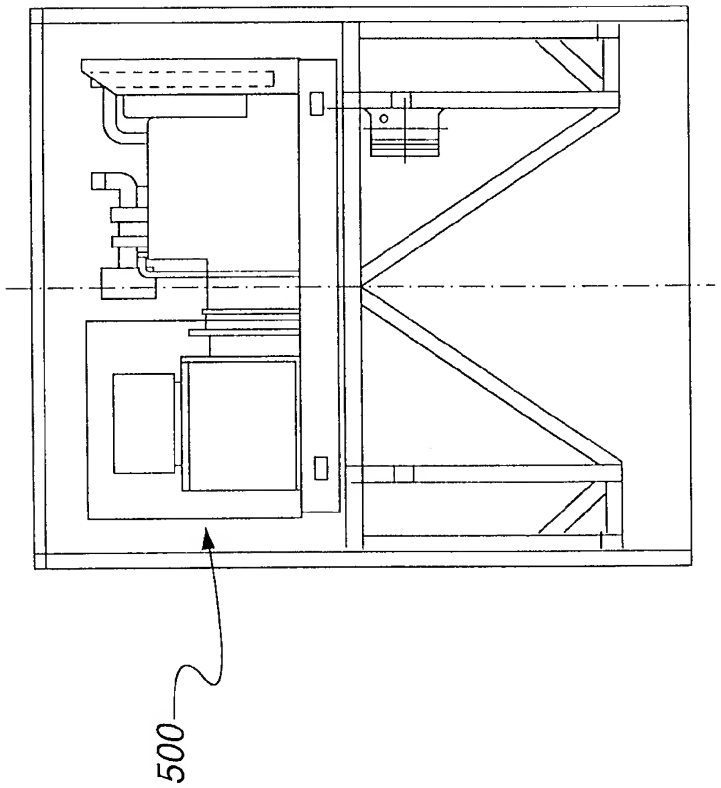
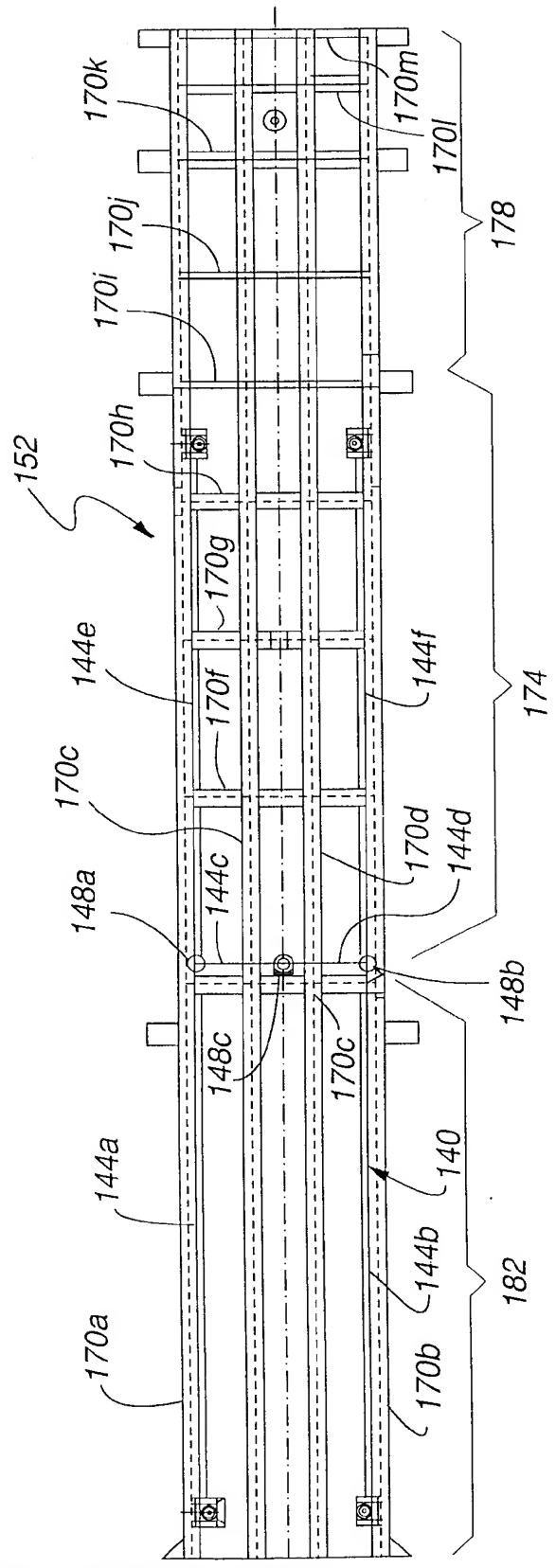


Fig. 7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170m
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170j
170i
170h
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170g
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144a
144b
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170a
170b

Fig. 8

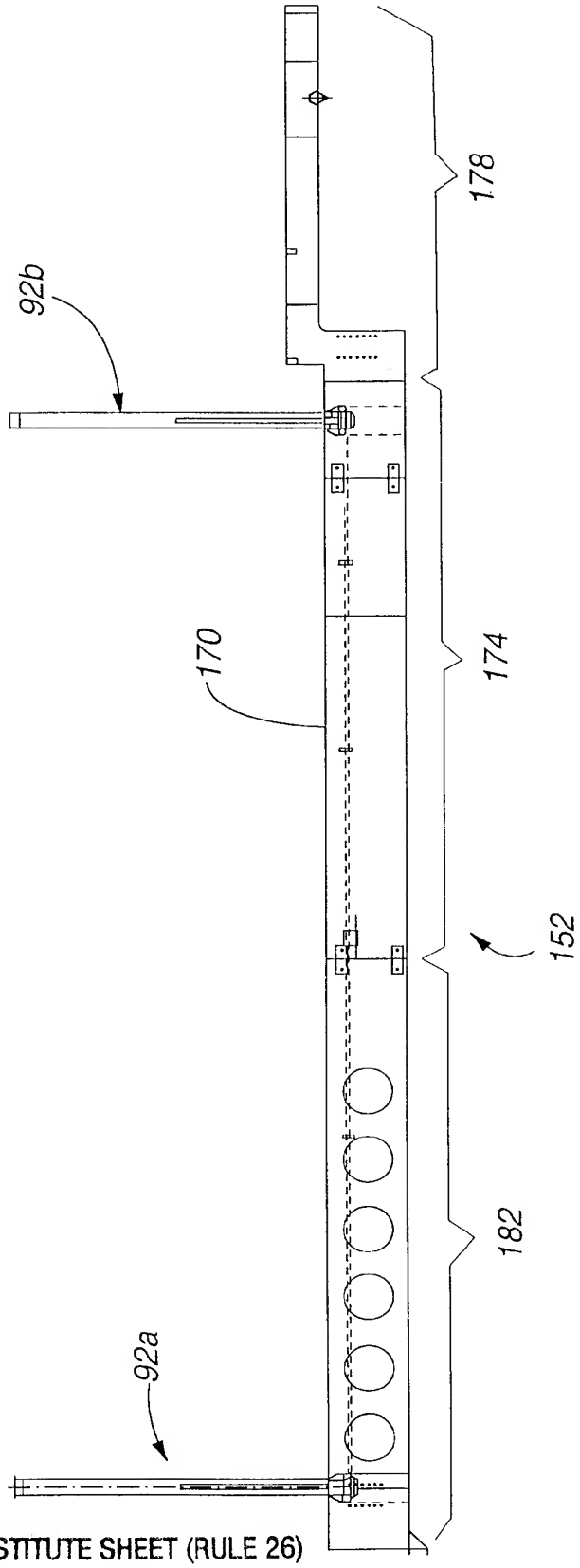


Fig. 9

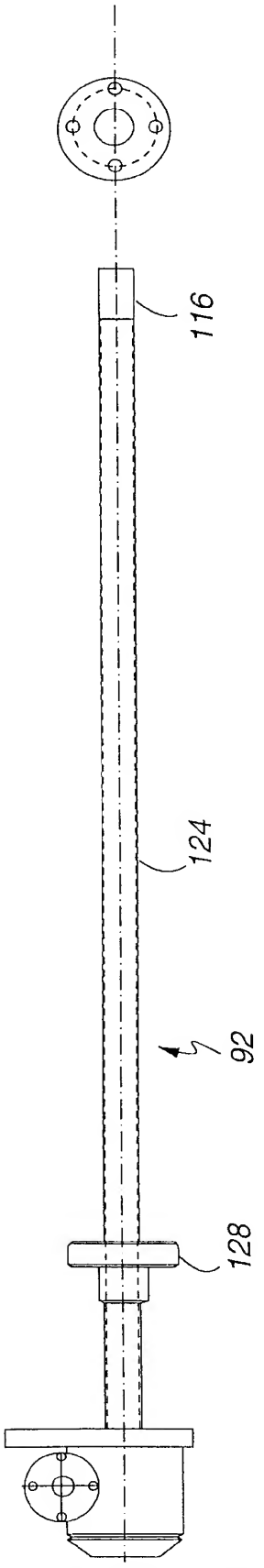


Fig. 10

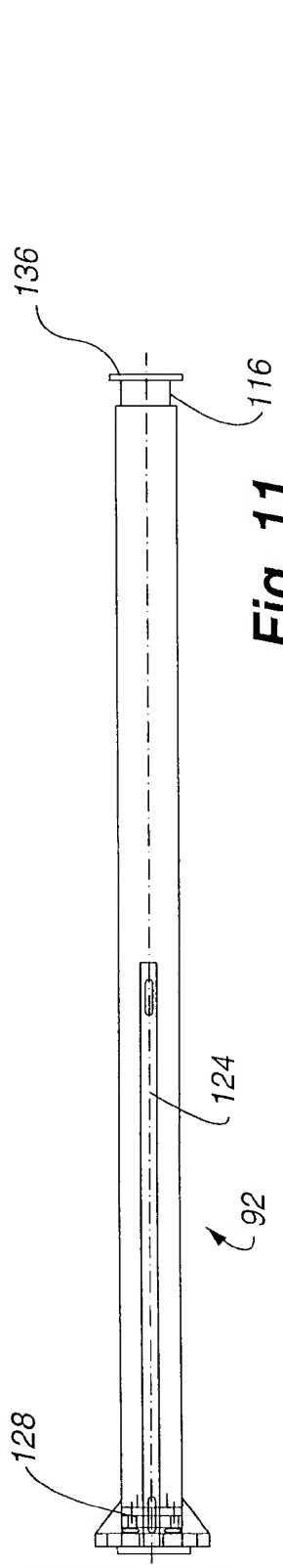


Fig. 11

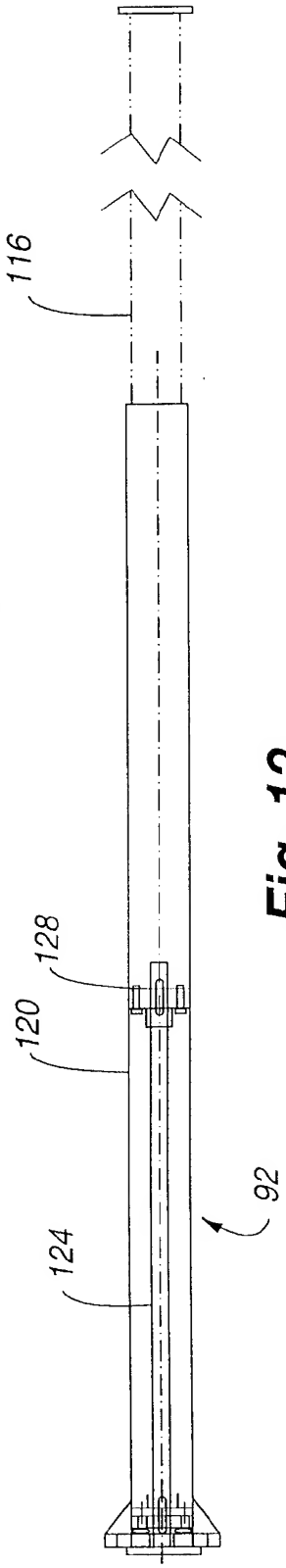


Fig. 12

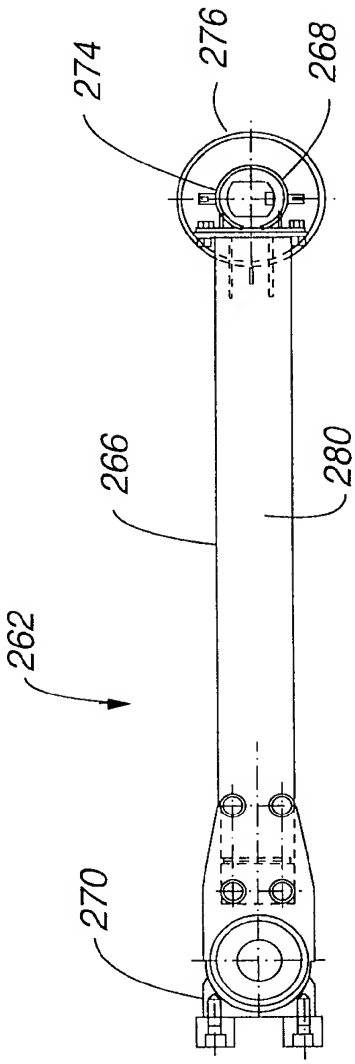


Fig. 13A

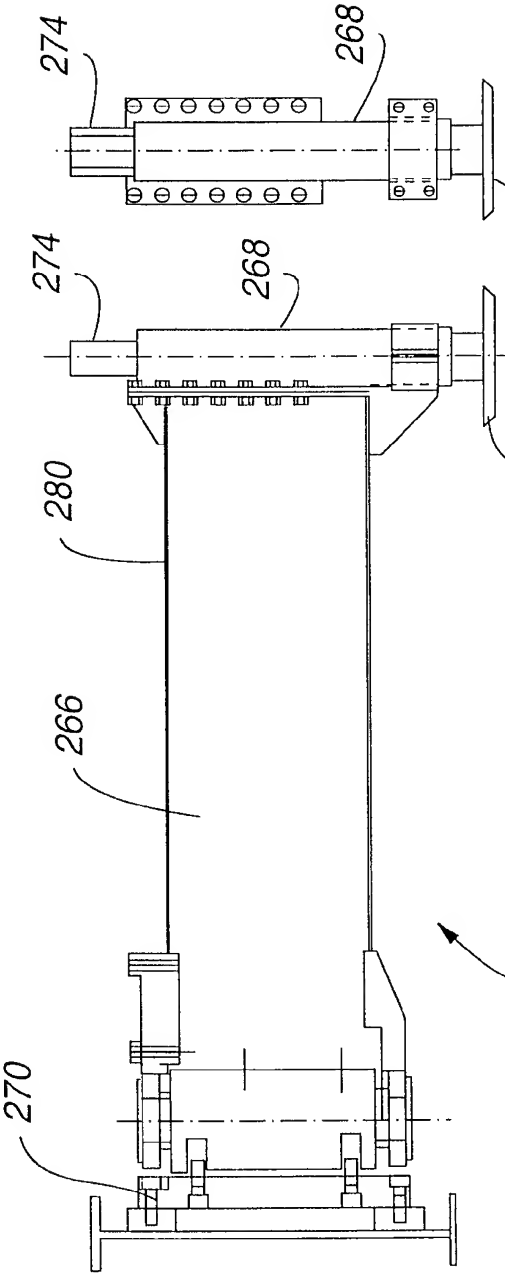


Fig. 13B

Fig. 13C

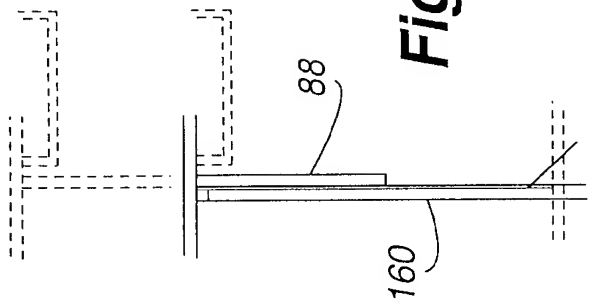


Fig. 16

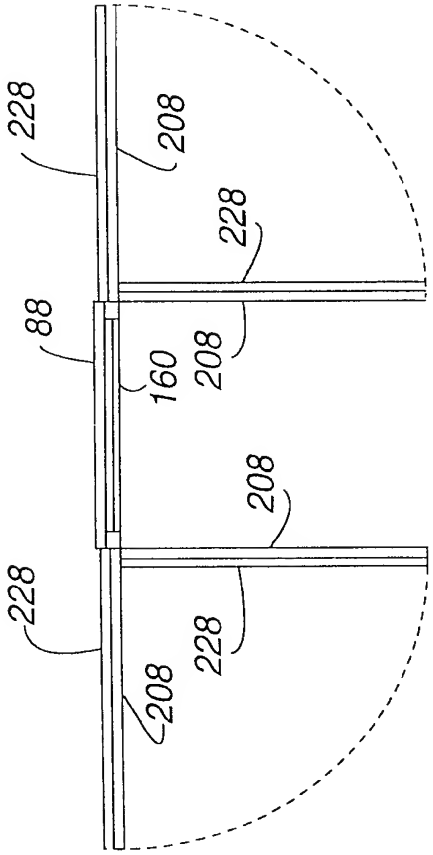


Fig. 14

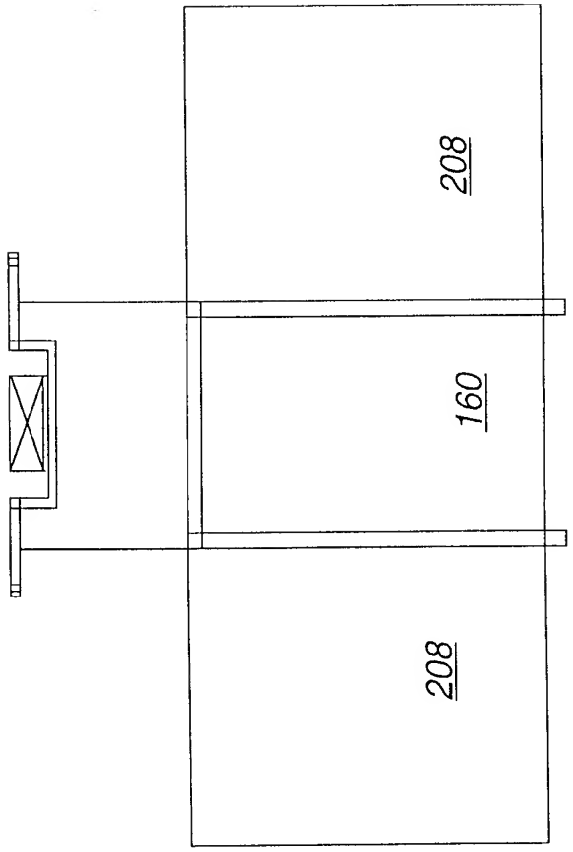


Fig. 15

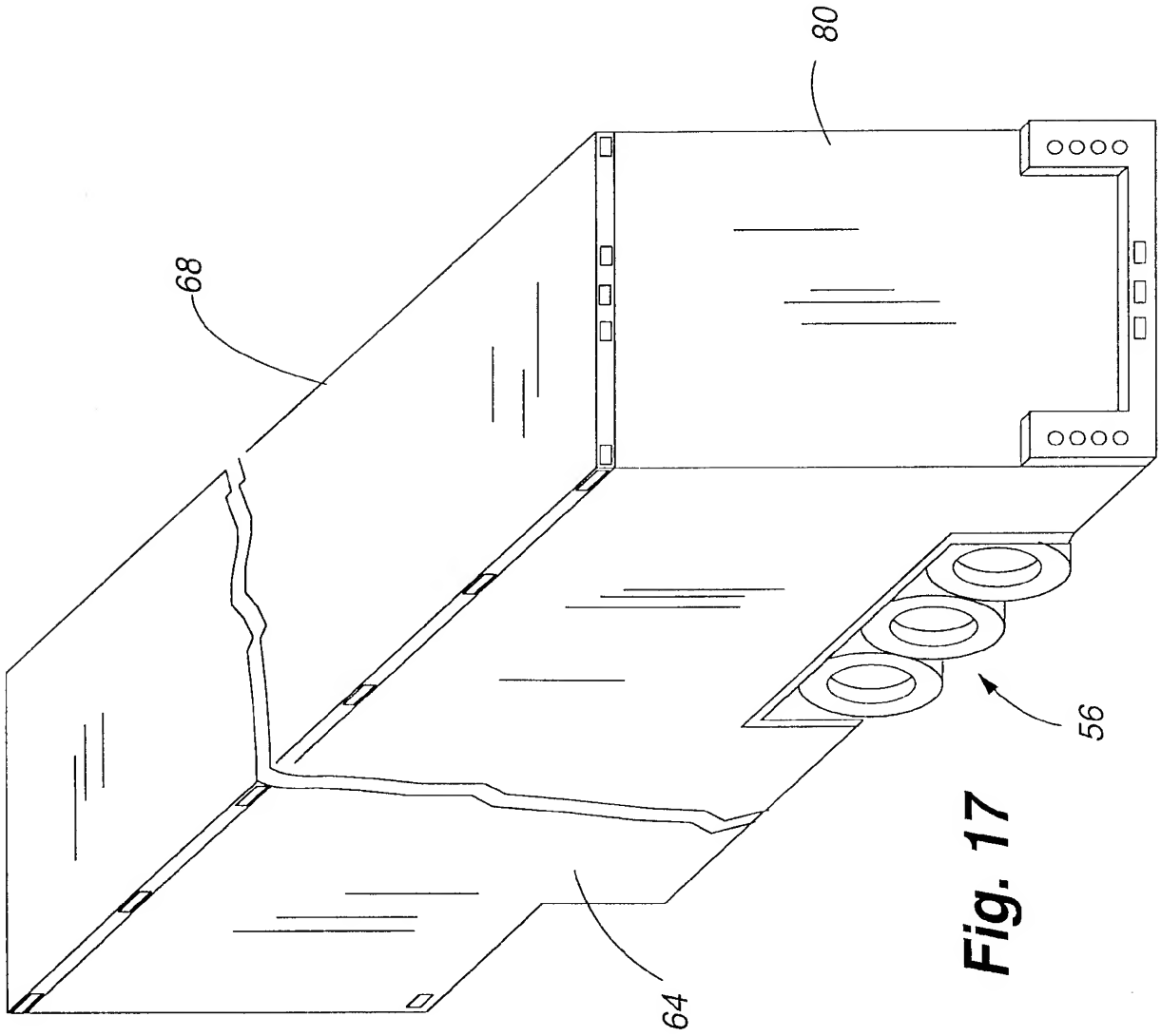


Fig. 17

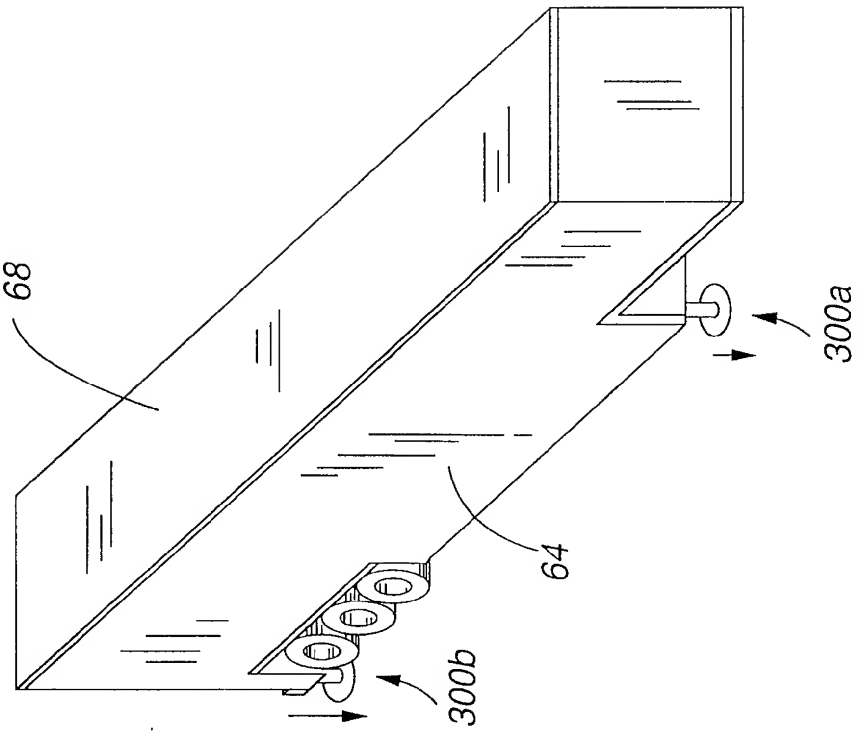


Fig. 19

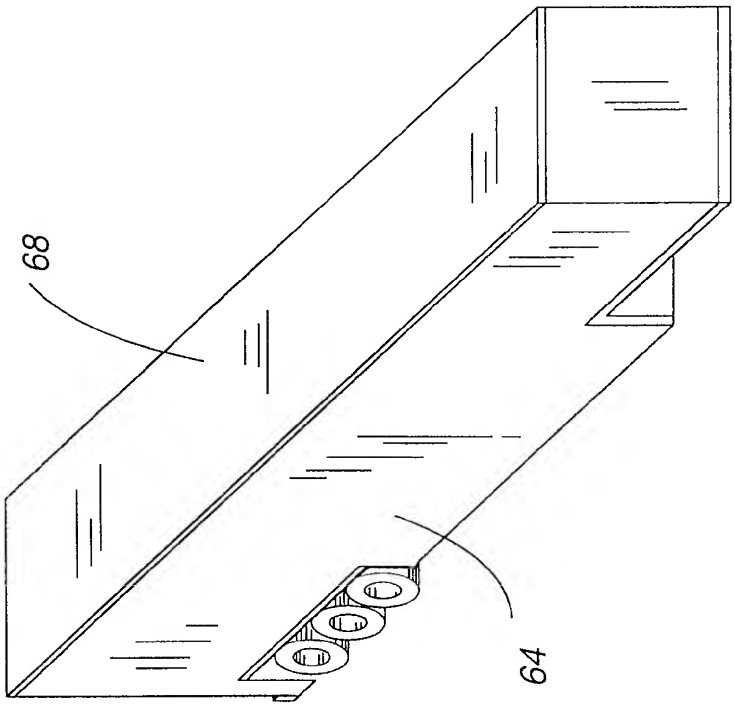


Fig. 18

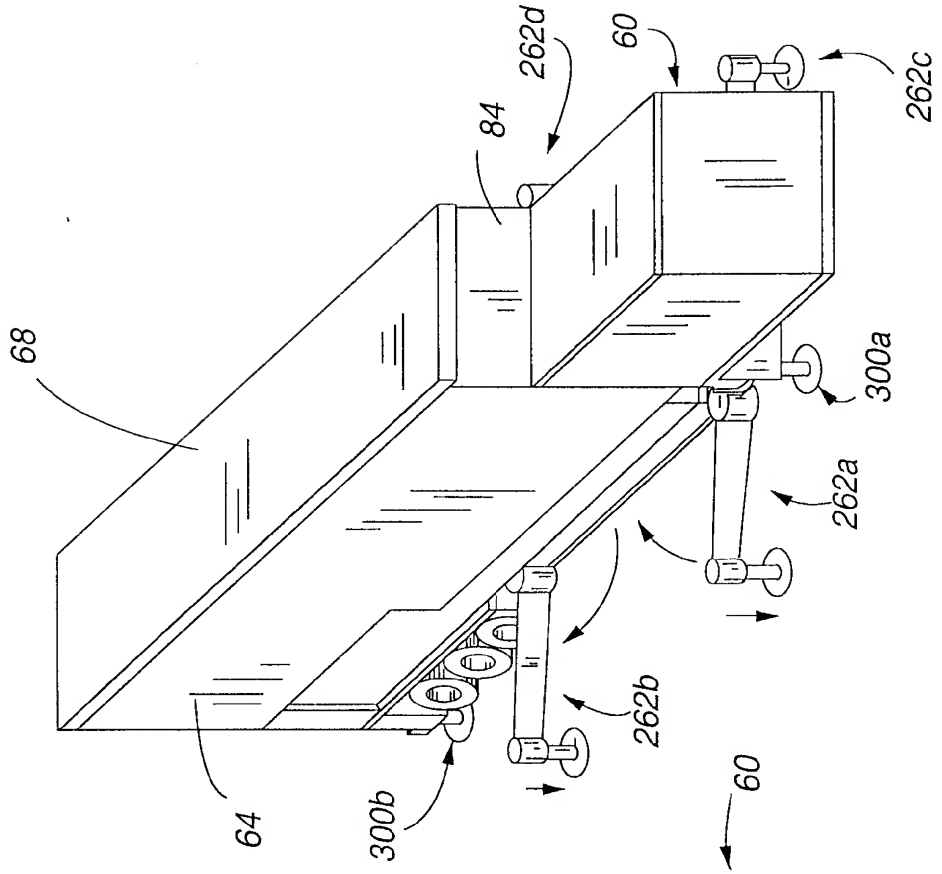


Fig. 21

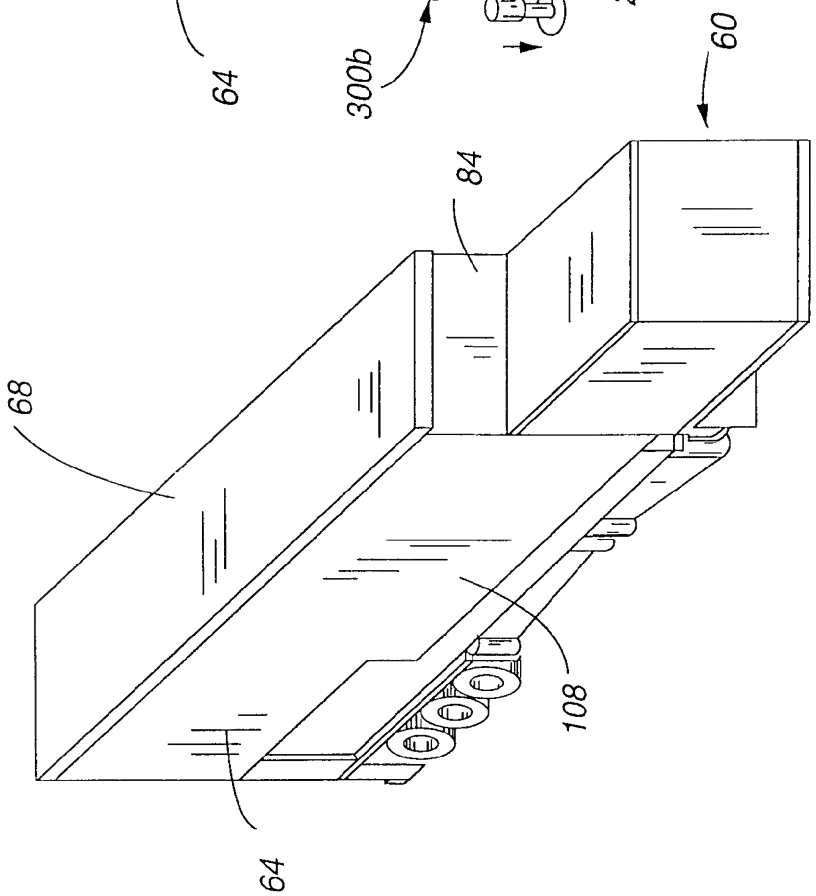
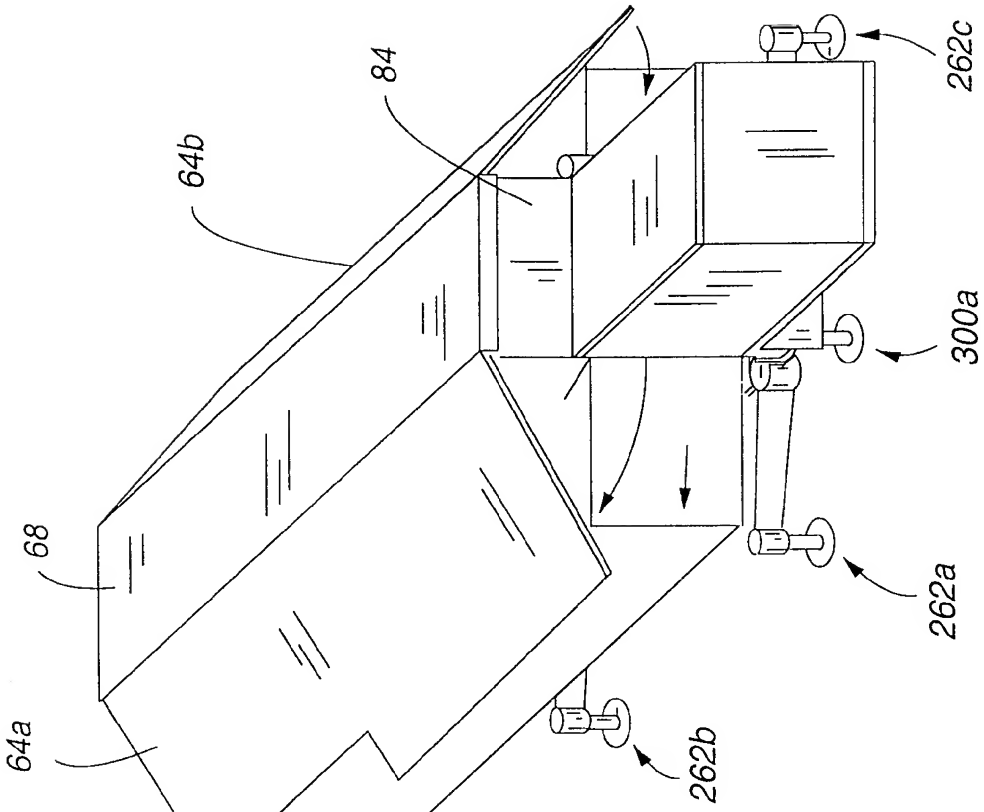


Fig. 20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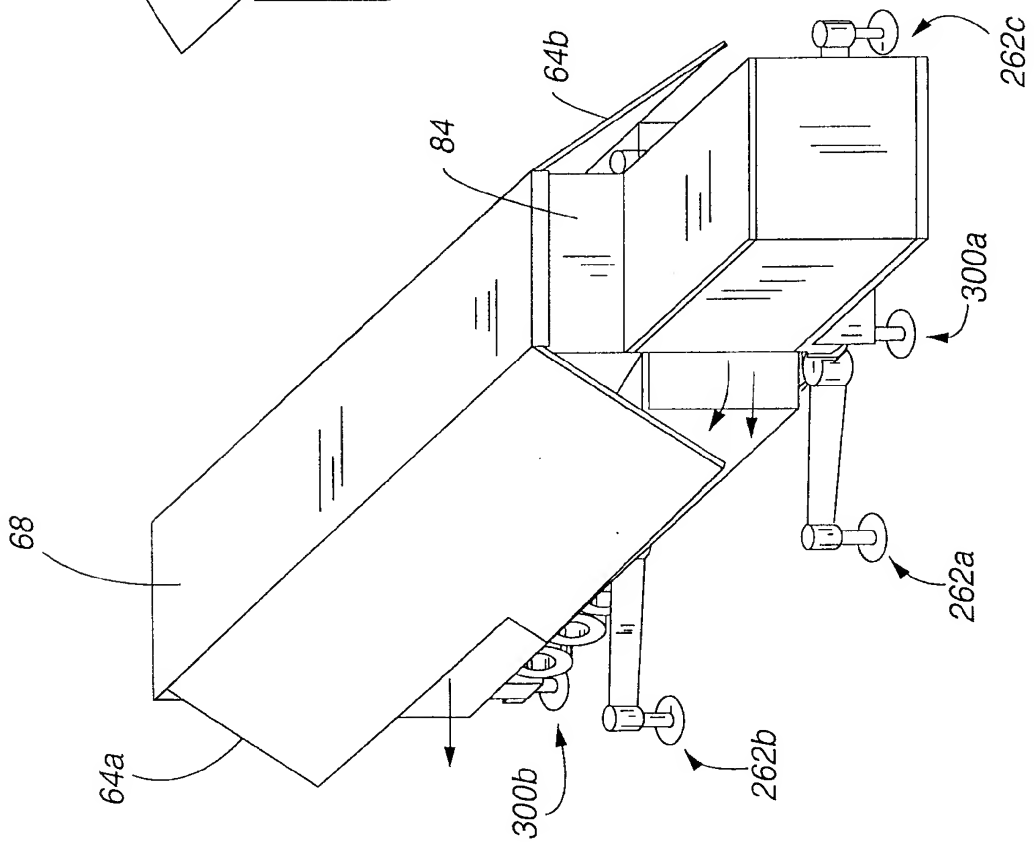
68
262a
64a
262b

Fig. 23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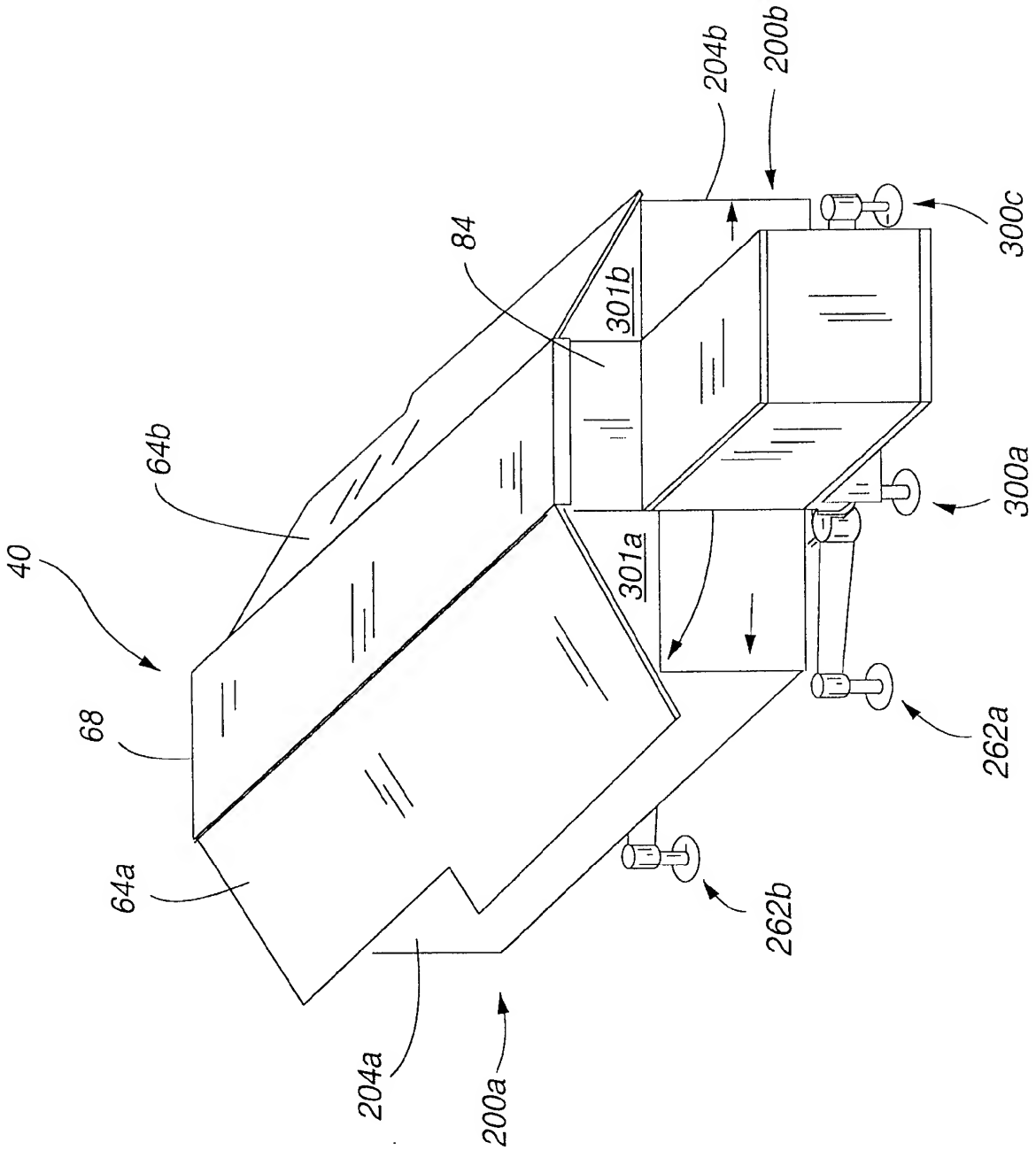
300a
68
262a
64a
300b
262b

Fig. 22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262b
204a
200a

Fig. 24

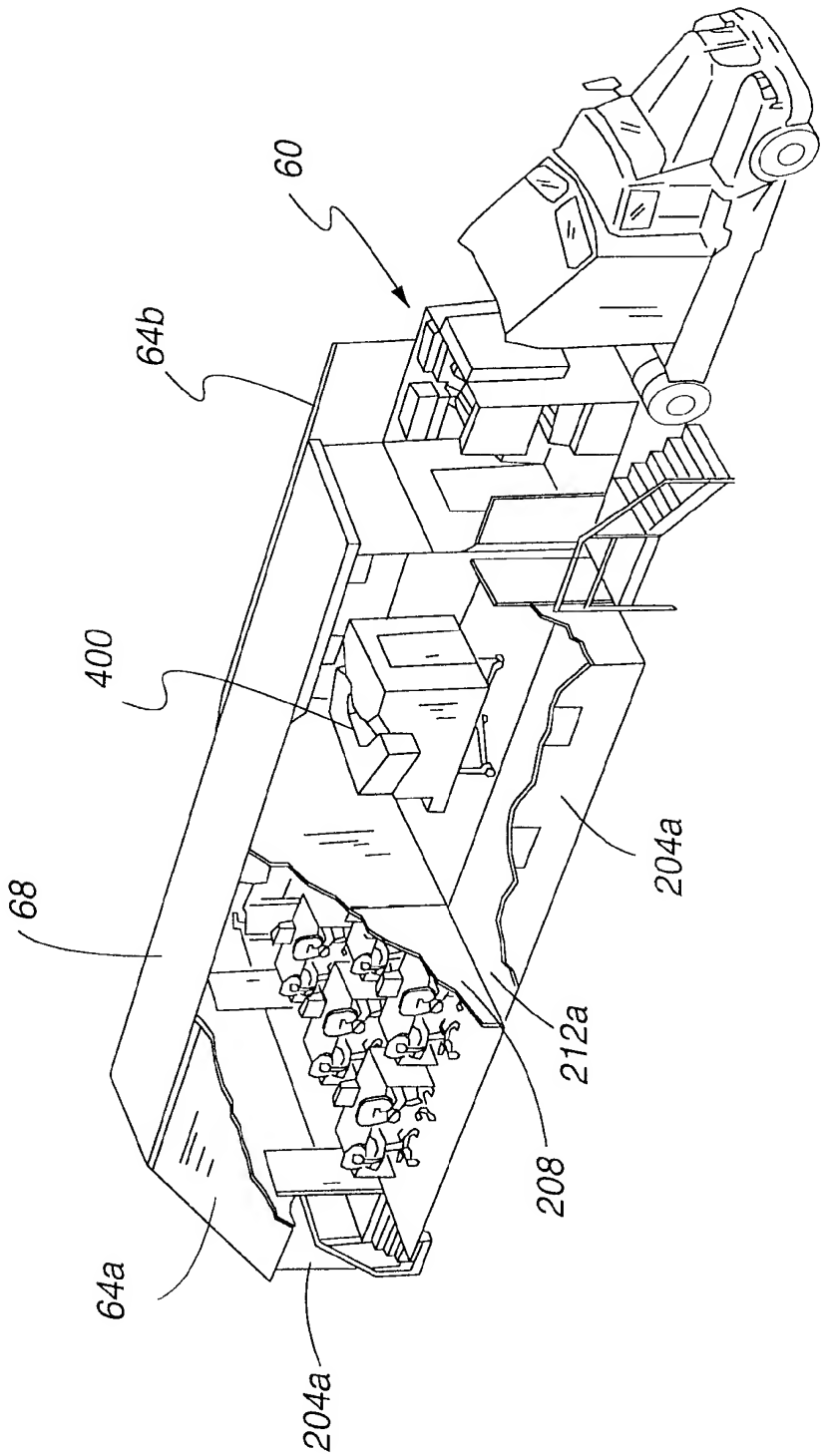


Fig. 25

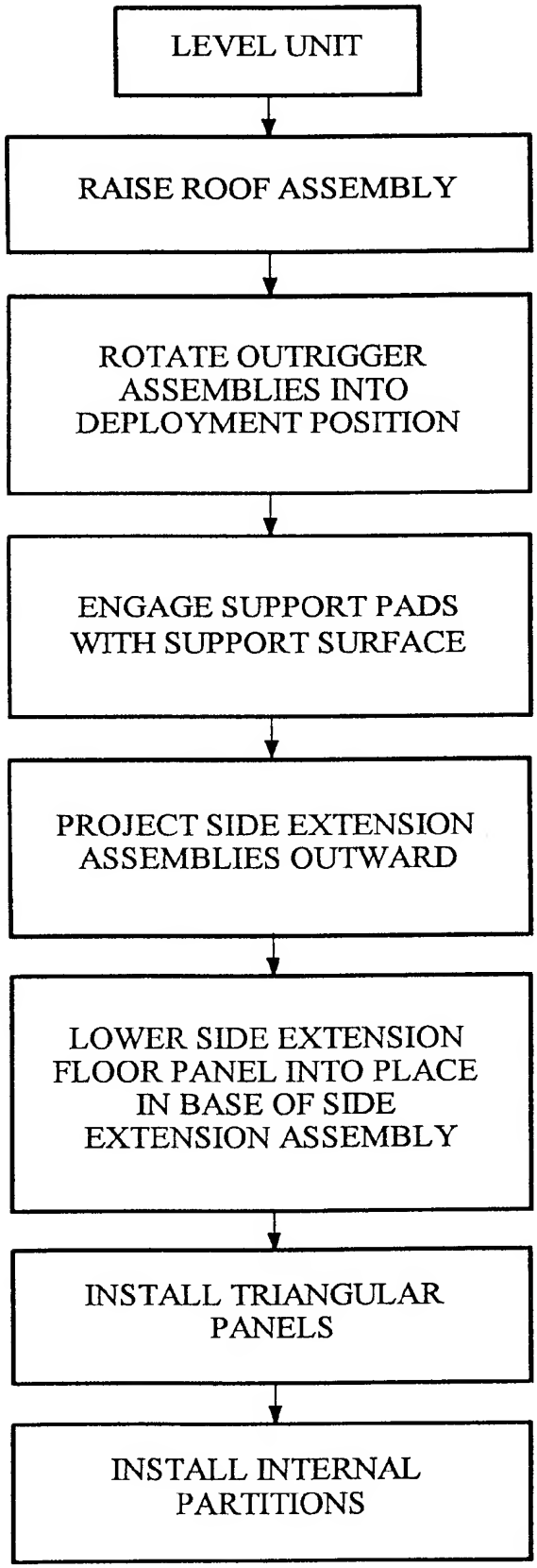

LEVEL UNIT
RAISE ROOF ASSEMBLY
ROTATE OUTRIGGER ASSEMBLIES INTO DEPLOYMENT POSITION
ENGAGE SUPPORT PADS WITH SUPPORT SURFACE
PROJECT SIDE EXTENSION ASSEMBLIES OUTWARD
LOWER SIDE EXTENSION FLOOR PANEL INTO PLACE IN BASE OF SIDE EXTENSION ASSEMBLY
INSTALL TRIANGULAR PANELS
INSTALL INTERNAL PARTITIONS

FIG. 26

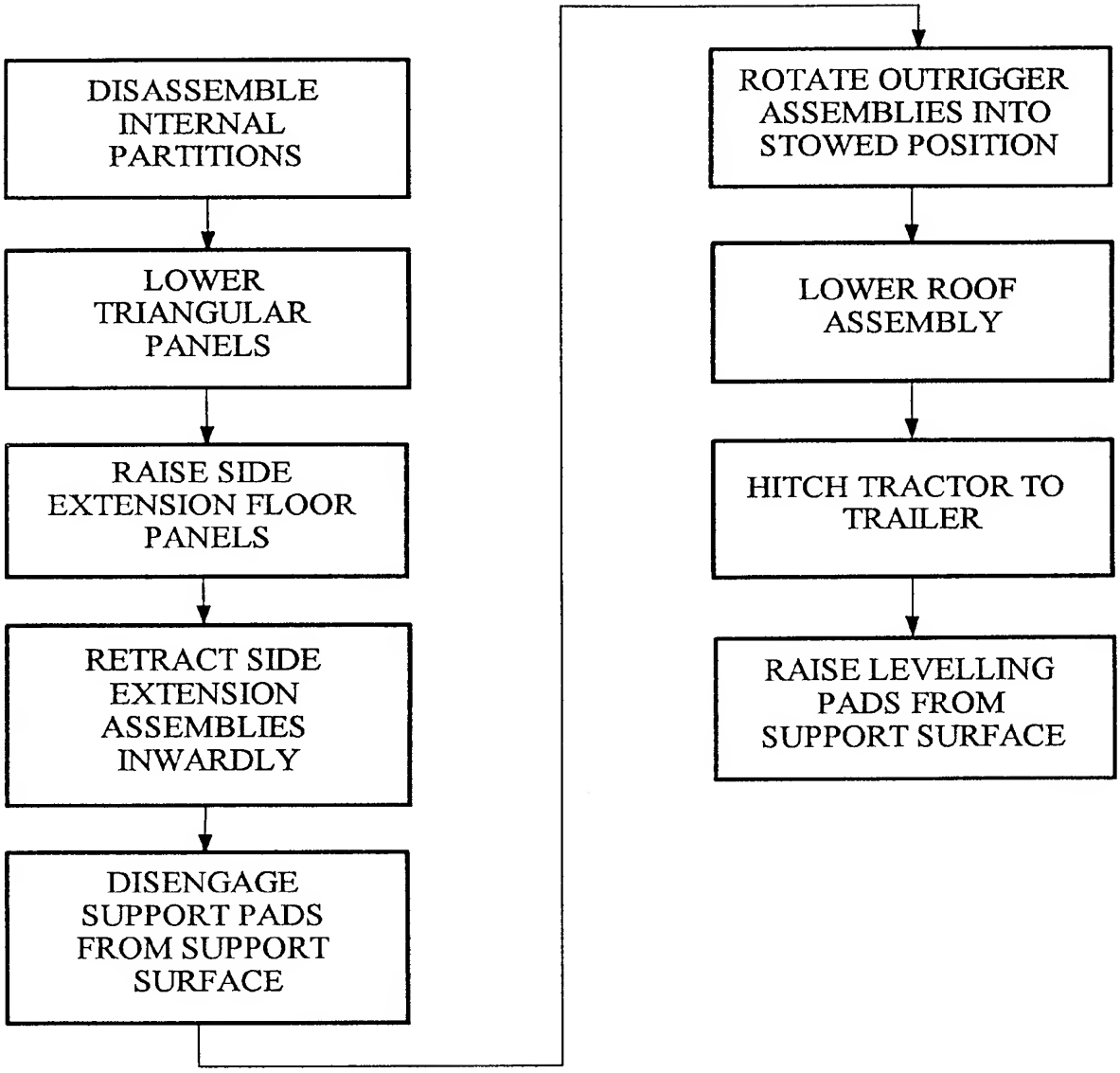
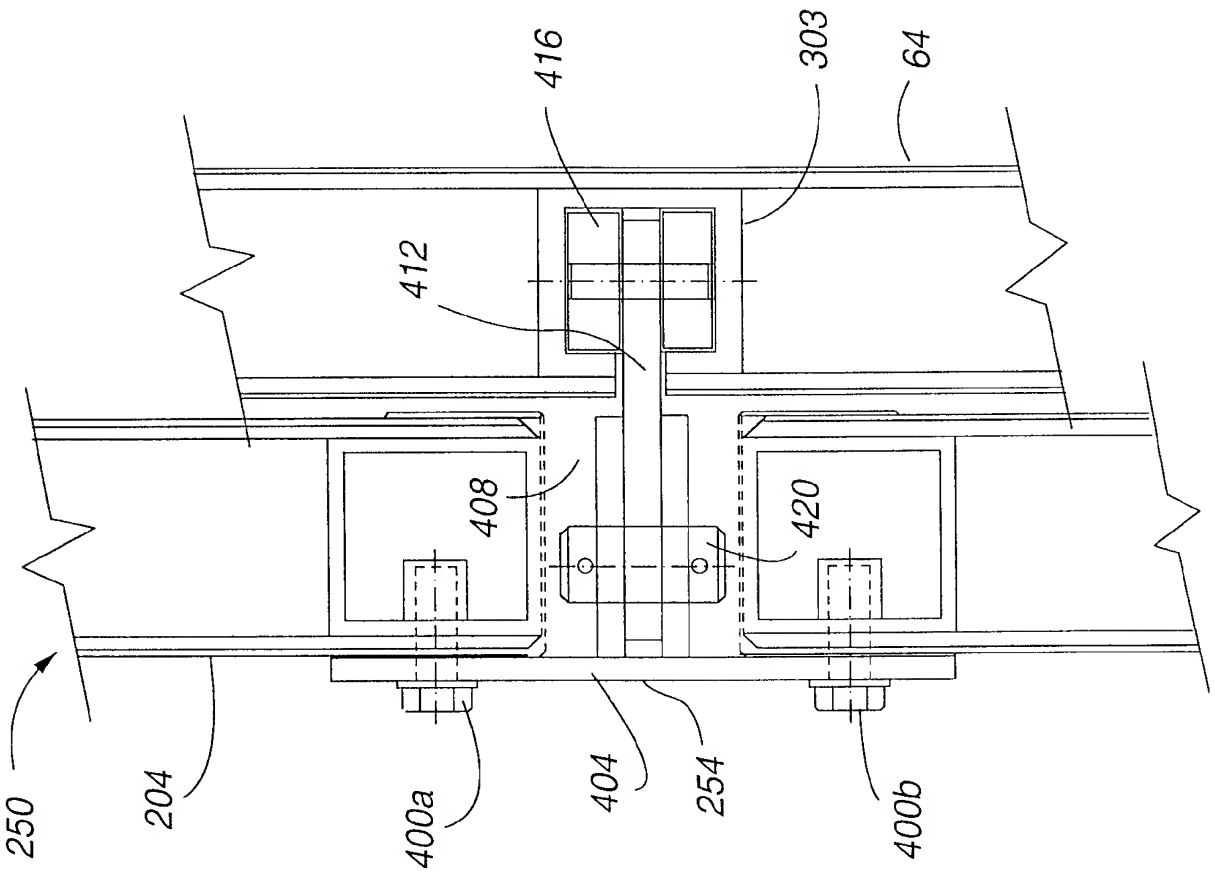

DISASSEMBLE INTERNAL PARTITIONS
LOWER TRIANGULAR PANELS
RAISE SIDE EXTENSION FLOOR PANELS
RETRACT SIDE EXTENSION ASSEMBLIES INWARDLY
DISENGAGE SUPPORT PADS FROM SUPPORT SURFACE
ROTATE OUTRIGGER ASSEMBLIES INTO STOWED POSITION
LOWER ROOF ASSEMBLY
HITCH TRACTOR TO TRAILER
RAISE LEVELLING PADS FROM SUPPORT SURFACE

FIG. 27

Fig. 28A



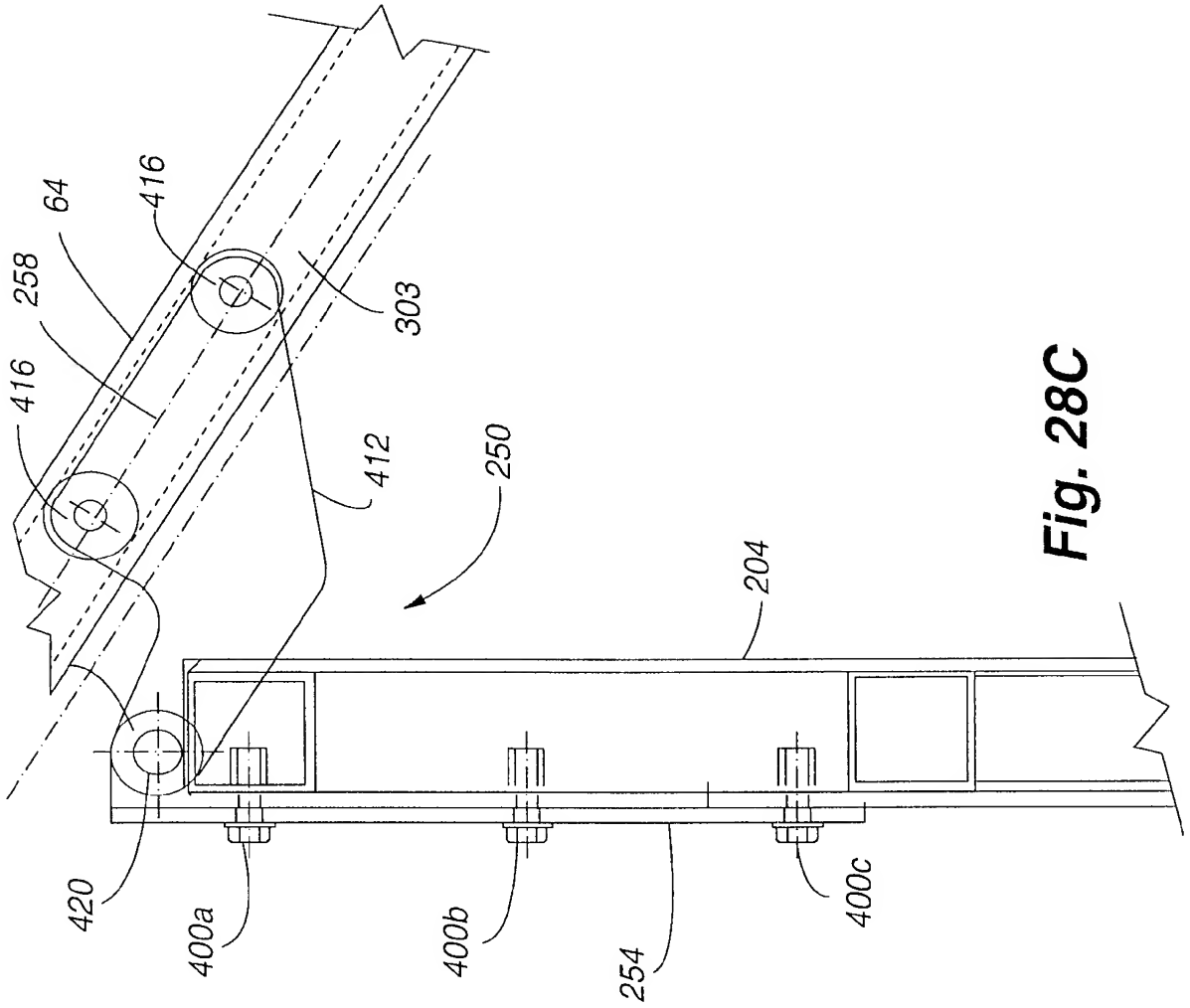


Fig. 28C

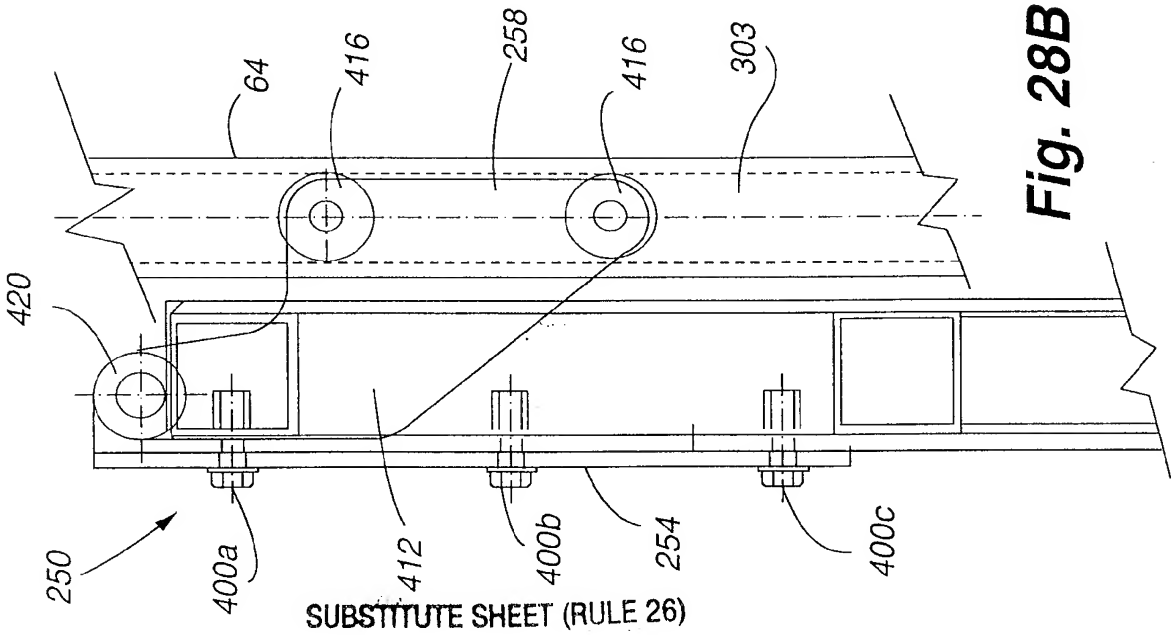


Fig. 28B